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Management Science Group
Abstracts
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Management Science Group

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Management Science Group

Preface

The purpose of this report is to make available to interested people information on the existence and content of research going on in the Management Science Group of the Sloan School of Management. The report contains

1. Titles and abstracts of M.S.G. faculty publications for the period of July 1972 through June 1973.
2. Abstracts of theses supervised by M.S.G. faculty during the same period.

If further information is desired about any specific item, the individual authors may be contacted. Estimates of copies of theses may be obtained from the Micro Reproduction Laboratories, 14-0551, M.I.T.

John D. C. Little

MANAGEMENT SCIENCE GROUP FACULTY

1972 - 73

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I. APPLICATIONS

1. Public Management

1.1 Family Planning

GLEN L. URBAN, A Model for the Management of a Family Planning System, SSM Working Paper 613-72, Revised June, 1973.

This paper describes a planning model designed to be used by managers of family planning systems to improve understanding, forecasting, and planning. The macro-flow model describes the patient movement through post partum and non-post partum programs. The flows model the phenomena of: outreach recruitment, continuance, post partum checkups, switching methods, referral, migration, contraceptive use experience, private protection, method effectiveness, advertising response, follow up, abortion, and medical services. Strategic variables can be linked to the flow parameters to produce capacity requirements and budgetary implications. The output includes benefit measures of total active patients, couple years of protection, "births protected", and unwanted births prevented. The fertility aspects of births prevented are modeled through a non-stationary Markov process submodel which considers demographic phenomena without burdening the basic flow structure. The input procedures used to process patient visit, outreach, clinic survey, and experimental data are discussed and some empirical results are reported. The combination of data based estimates and subjective judgment is done by "fitting" the model to past observed data. Testing and control are done by "tracking" model performance through conditional prediction, diagnosis, and updating.

The model is implemented in an on-line, conversational program that facilitates evolutionary model building by allowing the user to specify his model options. The application and testing of the model in the Atlanta Area Family Planning System are discussed and the experiences of managers in using the model to gain new insights, forecast, budget, and plan are reported.

GLEN L. URBAN, Using a Model as a Practical Management Tool for Family Planning Programs., (with R. W. O'Connor) American Journal of Public Health, (November, 1972).

One point of departure for examining the use of information and reporting systems by managers in an organization, including those concerned with family planning, should be a review of what those managers actually do. What activities are carried out? What kinds of decisions does the manager face? What information supports these activities -- and how, in fact, is the information used to meet managerial needs?

In organizing this discussion of local family planning program management, we will briefly: 1) introduce a framework to define and position the decisions faced by family planning managers; 2) use this framework to outline the areas in which most management information system work has been done to date and where substantial work remains to be done; and 3) present an approach to the structuring of some strategic planning decisions related

to family planning: Specifically, experience with a planning model, use of supporting data systems, and a particular application in Atlanta, Georgia, will be discussed.

1.2 Citizen Feedback

JOHN D.C. LITTLE, "Puerto Rico's Citizen Feedback System," in Drake, Keeney, and Morse, eds., Analysis of Public Systems, (with C.H. Stevens, and P. Tropp), M.I.T. Press, 1972.

Citizen Feedback may be defined as information from citizens directed to societal institutions, particularly government, in order to improve their functioning. Feedback can be divided into two broad categories: service feedback, which includes inquiries, requests and complaints, and opinion feedback, which includes opinions, suggestions, and volunteering.

A service feedback system has been established in Puerto Rico. A Feedback Division is part of the Governor's Office and is staffed by Citizen Aides whose function is to respond to letters, phone calls, and visits from citizens. The Citizen Aide is a "non-buck-passer," that is, if a citizen is referred elsewhere in government, the aide retains responsibility for following through on the case. An island-wise 24 hour phone service makes the system available to citizens at all times. Feedback reports provide information on the numbers and types of citizen concerns, including requests for service, complaints about government programs, and the delays in providing service. This information can then be used by the executive department and other branches of government to improve government functioning.

1.3 Productivity

GORDON F. BLOOM, "Distribution of Food," Chapter 12 in U.S. Nutrition Policies in the Seventies, Jean Mayer, ed., San Francisco: W.H. Freeman and Company, 1973, pp. 124-139.

In this chapter the writer directs his attention to the role than can and should be played by food retailers in providing better nutrition for American consumers. The shortcomings of the food distribution system in meeting the needs of low-income shoppers both in urban and rural areas are analyzed. The need for amendment of the food stamp program and for nutritional education is also discussed.

APPLICATIONS: Public Management

GORDON F. BLOOM, "The Systems Approach to Improved Productivity in Distribution," International Journal of Physical Distribution, Vol. 3, No. 3, Spring 1973, pp. 174 - 181.

The article discusses the evolution of the systems approach and points out that there are major discrepancies between maximization of a company's productivity and industry productivity. Examples are cited from experience in the food industry in the United States. The need for standardization and for a systems approach through industry committees in order to reduce distribution costs is examined.

1.4 Energy

GORDON M. KAUFMAN, "Reward and Uncertainty in Exploration Programs," (with Paul G. Bradley), Arctic Geology, Memoir, No. 19, The American Association of Petroleum Geologists, 1973.

The attractiveness of a petroleum exploration program depends on the expected return and the associated risk. Previous analyses of drilling programs have dealt with particular aspects of uncertainty. The variable which has received the most attention has been size of reservoirs. Various skewed probability density functions have proved consistent with empirical observation. Estimates of the expected value and variance of this variable have been casually interpreted as measures of the economic reward and the degree of risk, respectively, of specific exploration programs. The size of reservoir found, however, is only one aspect of the uncertainty in exploratory drilling. Among the other variables which have an important bearing on the economics of the program are the probability of making a discovery, the depth of the producing formation, and the productivity of the wells. The possible stochastic descriptions of the most significant variables have combined effects on the attractiveness of a venture.

GORDON M. KAUFMAN, "Two Stochastic Models Useful in Petroleum Exploration," (with Paul G. Bradley), Arctic Geology, Memoir, No. 19, The American Association of Petroleum Geologists, 1973.

What probability law characterizes the spatial distribution of oil and gas fields in a petroleum province? How does the probability that a wildcat well will penetrate a reservoir change (if at all) as the history of a basin unfolds?

The answers to these questions are important inputs to any model of the process of exploring for oil and gas. Some attention has been devoted to these questions, but there are deficiencies in the treatments of each.

Our objective is twofold: (1) to posit a reasonable model of the spatial distribution of petroleum reservoirs that conforms to several empirically observed facts about such distribution; and (2) to examine a simple first-order

model of the exploration process that allows one to test empirically the hypothesis that, at an early stage in the exploration of a basin, the process behaves like sampling without replacement.

The techniques of inference outlined will be useful in predicting properties of an unexplored region.

1.5 Transportation

JOHN D. C. LITTLE, "The Mixed-Integer Optimization of Traffic Signal Settings in a Network," (with N. Gartner, and H. Gabbay), Revision 2, Operations Research Center, M.I.T., March 1973.

The optimal setting of traffic signals in a network requires the determining of red and green times at each signal and the relative timing among signals so as to minimize average drive delay or other measure of performance. A model of traffic has been formulated and its optimization is being approached through mixed-integer linear programming. Test runs using the IBM package MPSX have been encouraging.

APPLICATIONS

2. Private, Non-Profit Organizations

2.1 Health Clinics

J. F. ROCKART, "Computer-Assisted History Taking - Do Patients Resent It?", (with E. R. Mclean and Jhg Arabian), The Hospital Medical Staff, June 1973.

Over the past twenty years, attempts have been made to employ computers to aid physicians in taking patients' medical histories. Although generally successful from a technical standpoint, these computer-based medical history systems have been challenged by some physicians who believe that they dehumanize the practice of medicine and that patients resent the use of such techniques.

In reviewing published descriptions of these systems, little evidence is found to support this concern. Researchers employing different approaches at a number of different sites have found that patients react quite favorably to this type of computer assistance.

At the Lahey Clinic, the use of a computer-processed medical history questionnaire now is administered routinely to all new patients. To date, more than 30,000 patients have been given the Lahey questionnaire. Recently, 2,000 of these patients were questioned about their reaction to this technique. Of these, 1,138 patients did not react strongly enough to bother returning the attitude survey questionnaire, 379 returned them with no comments pertinent to the medical history questionnaire, 477 were mildly to strongly favorable and only 6 were unfavorable. These results are consistent, therefore, with the experience of others who have used computers in this fashion.

J. F. ROCKART, "Interim Results of an Ambulatory Scheduling Project," (with R. C. Harrison, and B. E. Stangel), Lahey Clinic Foundation Bulletin, Volume 22, No. 1, January-March, 1973.

Over the past few decades many new medical techniques have been developed to assist physicians in delivering improved care to patients. Relatively little has been done with regard to developing new and improved administrative systems to assist in the delivery of medical care. In an attempt to fill this gap our research group at the Lahey Clinic Foundation has been investigating methods of facilitating the process of ambulatory care delivery with emphasis on the use of the computer to assist both the scheduling process and the delivery of care itself. In essence, this paper is an interim report of progress in this area and an indication of some future directions.

THE LAHEY PROJECT

The project's objectives are:

(1) Reducing the unevenness of physicians' daily schedule loads.
(2) Expediting the patient's progress through the Clinic
(3) Improving clerical systems, and
(4) Assisting the management of the ambulatory care delivery process.

APPLICATIONS: Private, Non-Profit Organizations

Some of the endeavors of the research unit have strictly been administrative. More than 20 physicians have been involved, in some manner, in the projects that have affected medical practice and six now provide inputs to the project as members of the Medical/Computer Systems Committee.

To date the work has centered in four substantive areas -- assisting physicians through the provision of information, improving the routing process, analyzing patient service time, and providing computer assistance to appointment secretaries and management.

J.F. ROCKART, "Medical Records Storage; A Method for Determining Level of Activity," Health Services Research, Winter 1972.

On the basis of return-visit patterns, a method is presented for determining which medical records should be kept in the active file and how long such records should be kept active for criteria of desired file size, desired probability of record use, desired percentage of successful file searches, and relative cost of storage in active and inactive files. The method is relevant to both physical and computerized medical record files and can incorporate any additional visit patterns. Implementation of the system in the Lahey Clinic is described, and possibilities for further refinement of the method are discussed.

J.F. ROCKART, "Planning for an Automated Clinic Appointment System," (with P. Hoffman, and O.G. Barnett) originally printed in Hospital Topics, reprinted in Out Patient Services Journal Articles, second edition, Medical Examination Publishing Company, Ink. 1973.

Traditionally, ambulatory care has received low priority in the allocation of hospital funds, personnel and other resources. Increasing pressure on inpatient facilities, however, has forced a re-evaluation of outpatient needs and services. Expanding third-party coverage and the continuing rise in medical costs have also focused greater attention on expediting the delivery of non-acute care.

As a consequence of these factors and because of an evident need to maximize the use of existing facilities at the combined clinics of the Massachusetts General Hospital (MGH) and the Massachusetts Eye and Ear Infirmary (MEEI), a joint study was conducted by staff members of the clinics and the Laboratory of Computer Science. Its basic objective was to determine the desirability of a computer-based appointment scheduling system. Although an automated system has not yet been implemented, the findings of this project have significant implications for other institutions interested in the design of comparable applications.

J.F. ROCKART, "Questionnaire Becomes Preadmission Tool," (with E.R.Mclean and JHG Changey), Hospitals, J.A.H.A., Volume 47, June 16, 1973.

As the demands upon the physician's time have increased, techniques designed to help him meet those demands, such as the use of questionnaires to aid him in

gathering patient medical history data, have been introduced. At first, medical history questionnaires were given directly to the physician for his review; more recently, computerized data processing has been introduced to edit and summarize the data elicited by the questionnaires. In addition, on-line computers have been used to interrogate patients directly and to print out a summary of the interview for the physician't examination.

As the use of automated medical history systems increases, a legitimate question can be raised concerning the effects of such systems upon patients. Indeed, a concern of many physicians regardingthis technique is that patients might resent it. If, in fact, patients do object to it, their reluctance could be a serious impediment to its acceptance by the medical profession. Therefore, it is appropriate to examine published accounts of patients' attitudes toward these systems and to report on a recent study conducted at the Lahey Clinic Foundation in Boston.

2.2 Education

J. F. ROCKART, "A Method for the Integrated Use of Learning Resources and Education," Journal of Higher Education, April 1973.

The educational literature has recorded many individual advances in technique over the past few years. Self-study courses have been developed. Programmed instruction has been used. Interactive computer programs have been developed. Professors have learned to change dry lecture techniques to more stimulating class discussion. However, in most cases, these advances have been applied one at a time.

The course design discussed here sprang from the understanding that the diverse learning objectives which underlie a well-rounded and well-structured course lead to the utilization of many classes of learning material. These in turn demand diverse learning methods to be utilized -- with each type of material being matched by its most effective learning method and "delivered" by its most efficient resource -- professor, student, or technology. The implementation of this concept is reported in this paper.

The result was an integrated use of the available learning methods and resources - synergistically utilizing the best of each resource in the learning process. Measurable increases in student performance on examinations, course quality (as expressed by students), and academic productivity all resulted.

APPLICATIONS

3. Business

3.1 Marketing

W. H. HAUSMAN, Mail-Order Demands for Style Goods: Theory and Data Analysis, (with R. St.G. Sides), SSM Working Paper #611-72, July 1972.

A number of alternative data-generating processes are explored for mail-order demands for seasonal style-goods. Weekly demands for 126 items over an 18-week selling season provide the empirical data.

Arguments are presented which result in the following candidates for data-generating processes: (1) ratios of successive forecasts are distributed log-normally; (2) ratios of successive forecasts are distributed as t (Student); (3) actual demands during unequal time periods are distributed as negative binomial. Analysis of the data suggests the negative binomial data-generating process as both most closely representing the underlying process and being simple to adapt to a decision model. The paper concludes with an example of the use of the chosen data-generating process in a decision framework, and deals briefly with some issues of implementation.

JOHN D. C. LITTLE, Assumptions for a Market Share Theorem, (with David E. Bell), Operations Research Working Paper, OR 017-73, May 1973.

Many marketing models use variants of the relationship: market share equals marketing effort divided by total marketing effort. Usually, share is defined within a customer group presumed to be reasonably homogeneous and overall share is obtained by weighting for the number in the group. Although the basic relationship can be assumed directly, certain insight is gained by deriving it from more fundamental assumptions as follows: For the given customer group, each competitive seller has a real-valued "attraction" with the following properties: (1) attraction is non-negative; (2) the attraction of a set of sellers is the sum of the attractions of the individual sellers; and (3) if the attractions of two sets of sellers are equal, the sellers have equal market shares in the customer groups.

It is shown that, if the relation between share and attraction satisfies the above assumptions, is a continuous function, and is required to hold for arbitrary values of attraction and sets of sellers, then the relation is: Share equals attraction divided by total attraction. Insofar as various factors can be assembled into an attraction function that satisfies the assumptions of the theorem, the method for calculating share follows directly.

APPLICATIONS: Business

J. D. C. LITTLE, "Sistemas de Control Adaptable en Marketing," in M. A. McNiven, ed., Cuanto Invertir en Publicidad?, Instituto Nacional de Publicidad, Madrid, 1972.

- Una empresa debe aprender de sus propias experiencias en una manera organizada.
- Un sistema adaptivo para controlar las actividades ligadas con la commercializacion puede ser usado para responder preguntas administrativas basicas.

PHILIPPE A. NAERT, Alternative Markup Decision Rules and Their Profit Implications, SSM Working Paper # 612-72, September 1972.

In studies of a company's marketing mix, markup decisions have not received much attention. A meaningful analysis of such decisions requires knowledge of the channel of distribution through which a product flows before reaching the final consumer, and of the distribution of power among various vertical levels in the channel. In this paper we will examine profit implications of alternative markup decision rules. The general ideas will be illustrated with examples.

PHILIPPE A. NAERT, Optimal Competitive Marketing Behavior in Oligopoly, (with Jean-Jacques Lambin and Alain V. Bultez), SSM Working Paper # 643-73, January 1973.

The problem of marketing mix optimization has received considerable attention in the literature. For the profit maximizing firm such an optimization is the extension of the "marginal revenue equals marginal cost" rule to determine optimal levels for all marketing instruments rather than just price. Dorfman and Steiner derived an optimization rule for a monopolistic firm [9], which was subsequently applied by Palda [27] and Lambin [20] in empirical studies.

A large number of normative models of competitive marketing behavior in oligopolistic markets have also been formulated. Various assumptions related to industry demand (stable versus expansible) and to the type of competitive reaction (follower versus leader) have lead to a large variety of models. Many of these are theoretical in nature and have not been directly applied, such as the competitive models, by Mills [23], Gupta and Krishnan [14, 15, 19], Shakun [29], Baligh and Richartz [2], Kotler [18], Naert [24], and others. Examples of empirical studies dealing with stable industry sales are Lambin (follower-type reaction) [22] and Telser (leader-type reaction [30], and with expansible industry sales are Schultz (follower) [28] and Bass (follower) [3].

In those studies where competitive reaction is explicitly taken into account (leader), it is implicitly assumed that competitors react with the same marketing instrument as the one which causes their reactions, that is, they react to a change in prices by a change in price, to a change in advertising by a change in advertising. We will identify this kind of reaction with the simple competitive reaction case. It is more realistic, however, and more in

the spirit of the very concept of marketing mix , to consider what we will call multiple competitive reaction, that is for example, a competitor may react to a change in price not just by changing his price, but also by changing his advertising and, possibly other marketing instruments as well. To our knowledge no optimality conditions have been derived yet for the multiple competitive reaction case.

In this paper we will remain within the realm of static analysis. First, we will derive profit maximization conditions for the multiple competitive reaction case. We will then demonstrate through a series of corollaries how optimization rules, previously developed, are special cases of our more general rule. The second part of this article will be devoted to the estimation problems arising in a multiple competitive reaction framework. Through the analysis of the data collected on a stable industry demand market, evidence of the importance of considering multiple competitive reactions will be presented.

PHILIPPE A. NAERT, Retail Outlet Location: A Model of the Distribution Network Aggregate Performance, (with Alain V. Bultez), SSM Working Paper #642-73, January 1973.

Location of sales outlets is of major concern to such organizations as oil companies, banks, etc. The problem is often approached in two steps. The total market is divided into regions, and the first stage amounts to deciding in which regions to expand or to contract. Thus for example in period t, the company (i) will add n_i^{1t} outlets in area 1, n_i^{2t} in area 2, etc. We will refer to the first step as the aggregate location problem. The second stage consists in choosing specific sites for these new outlets. In practice, these decisions are regarded as rather independent, especially because they are made at different levels in the organization. The number of new outlets is a corporate decision, whereas specific sites are selected at the regional level, subject however, to approval by the corporate headquarters. Many companies feel that, at least for the time being, hierarchical linking of the aggregate and detailed problems is neither worth the effort nor the cost.[1]

In this paper our sole concern will be with aggregate location. Our procedure will be closely related to a model developed by Hartung and Fisher [7]. However, their work lacked robustness, and suffered from a variety of deficiencies in the estimation of the model parameters. In section 2 we will review the Hartung-Fisher (hereafter (H-F) model and the various weaknesses associated with it. In section 3 the estimation problems will be examined. In section 4 we will propose various changes to the model which will make it robust, and we will use data from a major oil company in a European country to estimate the parameters and validate our approach.

APPLICATIONS: Business

ALVIN J. SILK, "A Fortran IV (IBM 360) Program for Multivariate Profile Analysis," (with Y. Allaire, and W. H. Tsang), Journal of Marketing Research, 10 (February 1973), pp. 81-82.

The program performs the computations required for the technique of multivariate profile analysis described by Morrison [4, pp. 141-8 and 186-94]. A mean profile is simply a graphical representation of a vector of average scores on several variables (e.g., psychological tests, semantic differential items) for a particular sample or treatment group.

The basic input data are commensurable measures of several variables obtained from members of independent samples representing various groups or experimental treatments. The variables must be expressed in comparable units. Sample sizes for different groups may be unequal.

The following output is provided:

1. Means are computed and printed for each variable and group.
2. Mean profiles are plotted for each group.
3. The hypothesis of parallel profiles or no groups-by-response variables interaction is tested by the largest characteristic root criterion using Heck's [2] θ_s statistic described in Morrison [4, pp. 166 and 188]. See [1, pp. 110ff] for a discussion of this and alternative criteria.
4. The hypothesis of identical profile heights or equal group or treatment effects is evaluated by a one-way univariate analysis of variance on the sums of the responses of each sample member across the NG groups. This test is only meaningful when the results of number 3 indicate no group-response interaction.
5. Simultaneous confidence intervals are calculated for all possible comparisons between pairs of groups for each response variable in the following manner [4, pp. 183-4]:

$$CI_{ij}^{k} = (\bar{X}_{ik} - \bar{X}_{jk}) \pm \left[\frac{\theta_s}{1 - \theta_s} (1/N_i + 1/N_j) \right]^{1/2}$$

where CI_{ij}^{k} = Confidence interval for differences in means between groups i and j for response variable k(i = 1,...NG-1; j = 2,...NG; k = 1,...NR).

$\bar{X}_{ik}, \bar{X}_{jk}$ = Mean values of variable k for groups i and j, respectively.

N_i, N_j = Sample sizes for groups i and j, respectively.

θ_s = Value read from Heck's charts [3; 4, pp. 312-9] of the upper percentage points of the greatest root distribution with reference to the desired α level and a set of parameters [4, p. 169] determined by the problem under consideration. References to sources of additional tables for θ_s are given in [1, p. 110] and [4, p. 167].

6. Univariate F-ratios are also computed for the same comparisons noted in number 5. See [3] for a discussion of the use of simulatneous confidence intervals and univariate F-tests in this type of problem. The results obtained for numbers 5 and 6 are of interest in situations where the parallelism hypothesis is rejected in number 3 and it becomes desirable to test

the equality of groups or treatments for each response variable separately. The program will handle problems satisfying the following capacity constraints:

$$NG \leq 8$$

$$NR \leq 20$$

$$TN \cdot NR \leq 16{,}000$$

where:

NG = Number of groups
NR = Number of response variables
TN = Total number of respondents (sum of the sample sizes across all groups).

Running time on a 360 system for a problem involving NG = 5, N = 16, and TN = 160 was 7 seconds.

ALVIN J. SILK, "Measuring the 'Qualitative Value' of Medical Journals as Advertising Vehicles," (with M. Ray), Working Paper, Marketing Science Institute, Cambridge, Mass., March, 1973.

In many if not most marketing situations there are both theoretical and practical reasons for believing that if a given audience were exposed to a particular ad for some product in one media vehicle rather than another, then the impact of such an advertising exposure would vary according to the vehicle in which the exposure occurred. Such a differential effect is commonly referred to as the "qualitative value" of media as advertising vehicles. The paper is concerned with developing measures of this phenomenon for use in advertising media planning. The first section of the paper reviews the relevant advertising research literature and identifies alternative ways to define and measure the concept. The second section of the paper develops an overall research plan geared to assessing qualitative value as three stages of the advertising decision process -- planning, pre-testing, and post-testing. The final section of the paper presents a detailed research design for a field study to measure the qualitative value of medical journals as advertising vehicles.

ALVIN J. SILK, "Testing the Inverse Ad Size-Selection Exposure Hypothesis: Clarifying Bogart," Journal of Marketing Research, 10 (May, 1973), 221-223.

A discussion of previous comments and empirical evidence bearing on the hypothesis that the association between prospect status and exposure to print advertising decreases as advertisement size increases.

APPLICATIONS: Business

GLEN L. URBAN, PERCEPTOR: A Model for Product Design, SSM Working Paper #640-73, January, 1973.

This paper presents a marketing model that aids managers in designing new products, repositioning old products, or realigning a product line.

The model is based on the use of multi-dimensional scaling to describe perception and preference. These joint space maps are basic elements in a process of perception, preference, and product choice. Attitude change is modeled by the feedback of product usage on perception or preference and by the effects of controllable marketing variables. The model encompasses the issues of: (1) heterogeneity of preference and perception, (2) differences in evoked sets, (3) naming of perceptual dimensions, (4) linking perception and preference to choice, and (5) aggregation of individual data for market descriptions. The outputs are the sales, shares, and profits of the brands in the market.

Consumer data on Canadian beer are used to estimate joint space maps and the linkages of attitudes to choice. These and the other measurement issues identified above are discussed. The parameters and structure of the model are examined based on predictive tests with saved data and alternative attitude formulations.

The model is implemented in an on-line conversational model. Considerable flexibility exists to customize the model structure based on statistical interpretation of perception, preference, and choice data. With the model, the manager can simulate the effects of repositioning, adding, or dropping a product. He also can examine the effects of controllable variables such as advertising and distribution on the dynamics of the market changes. With these capabilities, he can carry out a comprehensive review of the firm's product line strategy and guide the design of new products.

3.2 Production and Operations Management

PETER HAMMANN, A Re-Issue Policy Model, SSM Working Paper #634-72, December 1972.

Publishing firms of books and records follow a well-known policy of reissuing their products in a different format some time after the initial introduction. Paperbacks and budget-label discs are two typical formats. As they usually are accompanied by some price cut, two questions arise:

-When should the product be reissued?

-At what price should the product be marketed again?

The following paper considers these questions from the viewpoint of quantitative analysis. A simple model is presented, deriving from a case study in the recording industry. Possibilities of implementation are discussed.

APPLICATIONS: Business

ARNOLDO C. HAX, Hierarchical Integration of Production Planning and Scheduling, (with Harlan Meal), SSM Working Paper #656-73, May 1973.

This paper describes the development of a hierarchical planning and scheduling system for a multiple plant, multiple product, seasonal demand situation. In this hierarchical structure, optimal decisions at an aggregate level (planning) provide constraints for detailed decision making (scheduling).

Four levels of decision making are used: first, products are assigned to plants (using mixed-integer programming), making long-term capacity provision and utilization decisions; second, a seasonal stock accumulation plan is prepared (using linear programming), making allocations of capacity in each plant among product Types within which the products have similar inventory costs; third, detailed schedules are prepared for each product Family (using standard inventory control methods for items grouped for production since the Items in a Family share a major setup), allocating the type capacity among the product Families in the Type; fourth, individual run quantities are calculated for each Item in each Family, again using standard inventory methods.

The approximations used and the procedures developed are described in sufficient detail to guide a similar application. We also discuss the problems encountered in implementation and the approach used to resolve these problems. Finally, we estimate the costs and benefits of this system application.

ARNOLDO C. HAX, "Integration of Seasonal Planning and Detailed Scheduling," Proceedings of the 1973 Northeast Meeting of the American Institute of Decision Science (forthcoming).

This paper describes a case study dealing with the design and implementation of an integrated production planning, inventory control and scheduling system for a large manufacturing company. The objective of the system is to provide effective guidance in medium-term planning and operational decisions in a manufacturing activity affected by strong seasonalities in the demand pattern of the various products. The essential characteristic of the system is a hierarchical decision making approach in which the aggregate results of medium range planning define a context and constraints for the day-to-day decisions.

The paper describes the role played by each of the system modules and the way in which they interact to constitute an integrated planning, control and scheduling system. A reference is made to the costs and benefits associated with the system application, as well as the problems encountered in the system implementation.

ARNOLDO C. HAX, "Optimization of a Fleet of Large Tankers and Bulkers: A Linear Programming Approach," (with John Everett, Victor Lewinson and Donald Nudd, Marine Technology, 9, No. 4, 1972.

Linear programming was used to optimize fleets of large bulkers and tankers (including OBOs) for the 1980s. The fleet was intended to carry 15 percent of the U.S. foreign trade in the major dry and liquid bulk commodities. Guidance was obtained as to best ship designs and sizes, and, by sensitivity tests, benefits of standardization and backhauls were identified. Also, optimum

ship characteristics were shown to be more sensitive to port depth than to exact trade forecasts, and fleet savings from relaxation of port constraints were estimated.

ARNOLDO C. HAX, "Planning a Management Information System for a Distributing and Manufacturing Company," Sloan Management Review, 14, No. 3

Many managers see a need for more effective, mechanized information systems within their firms. While the benefits of better information make such systems desirable, the potential for disaster because of sudden and sweeping changes often discourages large-scale reform. Therefore, introduction of more advanced systems is not a simple task, and a plan for development of the system is a necessary prerequisite. In this article, Professor Hax develops a system plan for a hypothetical manufacturing and distributing firm. A classification procedure helps identify information needs within the firm, and priorities are then assigned to these needs. The author suggests a method for implementing the system and an organizational structure for directing this effort. Finally, the benefits and estimated costs of the plan are examined.

3.3 Other Business Applications

GORDON F. BLOOM, Economics of Labor Relations,(with Professor Herbert R. Northrup),Homewood Illinois: Richard D. Irwin, Inc, March 1973 (7th ed.).

This is the seventh edition of a labor textbook used in college courses in Labor Economics. The text covers history and government; collective bargaining; economics of the labor market; governmental regulation of wages and hours; governmental security programs; and governmental control of labor relations.

WARREN H. HAUSMAN, The Stochastic Cash Balance Problem with Average Compensating-Balance Requirements, (with Antonio Sanchez-Bell), SSM Working Paper #663-73, June 1973.

The problem under consideration involves the management of cash and short-term financial assets for a firm facing a compensating-balance requirement specified as an average balance over a number of days (e.g., weekly, bi-weekly, or monthly). Daily net cash flows are partially unpredictable and are treated as stochastic (specifically, as independent random variables). We consider only two assets: cash, and some interest-bearing assets.

At the end of a period, cash holdings in excess of the compensating-balance requirement incur an opportunity cost, in that they could have been invested in the interest-bearing asset. A cash level below the requirement presumably incurs some penalty cost, which will be assumed to be proportional to the shortfall. Transactions costs of converting excess cash into the earning asset and vice-versa make it uneconomic to "even up" daily, and create the management decision problem studied (in variations) here and in the references.

II. METHODOLOGY

1. Statistics and Stochastic Processes

G. M. KAUFMAN, Bayesian Factor Analysis, (with S. James Press), SSM Working Paper #659-73, May 1973.

In this paper we discuss the problem of factor analysis from the Bayesian viewpoint. First, the classical factor analysis model is generalized in several directions. Then, prior distributions are adopted for the parameters of the generalized model and posterior distributions are developed in the light of observed data. Finally, we develop a large sample marginal posterior distribution for the elements of the factor loading matrix. It will be seen that the Bayesian approach provides a formal mechanism for using subjective prior information to eliminate ambiguities and dogmatic constraints ever present in earlier factor analysis models.

G. M. KAUFMAN, "Two Distributions Involving a Bessel Function," Journal of the American Statistical Association, Vol. 67, No. 340, December 1972.

Properties of the distribution of a certain sum of a normal random variable and the reciprocal of a gamma random variable are examined. This sum appears naturally in the course of doing a Bayesian analysis of the lognormal process.

ROY E. WELSCH, "A Convergence Theorem for Extreme Values from Gaussian Sequences," Annals of Probability, 1, June 1973 , pp. 398-404.

Let $\{X_n, n=0, \pm 1, \pm 2,...\}$ be a stationary Gaussian stochastic process with means zero, variances one, and covariance sequence $\{r_n\}$. Let $M_n = \max \{X_1, ..., X_n\}$ and S_n = second largest $\{X_1, ..., X_n\}$. Limit properties are obtained for the joint law of M_n and S_n as n approaches infinity. A joint limit law which is a function of a double exponential law is known to hold if the random variables X_i are mutually independent. When M_n alone is considered Berman has shown that a double exponential law holds in the case of dependence provided either $r_n \log n \to 0$ or $\Sigma_{n=1}^{\infty} r_n^2 < \infty$. In the present work it is shown that the above conditions are also sufficient for the convergence of the joint law of M_n and S_n. Weak convergence properties of the stochastic processes $M_{[nt]}$ and $S_{[nt]}$ with $0 < a \leq t < \infty$ are also discussed.

ROY E. WELSCH, A Modification of the Newman-Keuls Procedure for Multiple Comparisons. SSM Working Paper 612-72, September 1972.

A major criticism of the Newman-Keuls multiple comparison procedure is that it fails to provide adequate protection against erroneous comparisons when the null hypothesis of equal mean values is violated. This paper presents a modified Newman-Keuls procedure which ameliorates the above problem without, in the opinion of the author, becoming unduly conservative. Tables are provided which make the new test easy to use.

METHODOLOGY: Statistics and Stochastic Processes

ROY E. WELSCH, A Multiple Comparison Procedure Based on Gaps, SSM Working Paper 628-72, November 1972.

This paper presents a multiple comparison procedure that examines first the gaps between adjacent ordered sample means, then the three-stretches, four-stretches, and so on until the range is reached. This reverses the order of most existing multiple comparison procedures. Tables have been constructed, using improved Monte Carlo techniques, that make it possible to use the new test.

ROY E. WELSCH, The Variances to Regression Coefficient Estimates Using Aggregate Data (with Edwin Kuh), SSM Working Paper 616-72, October 1972.

This paper considers the effect of aggregation on the variance of parameter estimates for a linear regression model with random coefficients and an additive error term. Aggregate and micro variances are compared and measures of relative efficiency are introduced. Necessary conditions for efficient aggregation procedures are obtained form the Theil aggregation weights and from measures of synchronization related to the work of Grunfeld and Griliches.

METHODOLOGY

2. Mathematical Optimization

T.L. MAGNANTI, "A Language for Mathematical Programming," (with G. B. Dantzig and S.F. Maier).

The Mathematical Programming Language (MPL) is a high level programming language that uses mathematical notation in an algorithmic structure suitable for communicating and testing Mathematical Programming algorithms. The language contains matrix and vector algebra, including partitioned matrices and arrays, set like indexing capabilities, and a number of provisions for function evaluation. It also provides dynamic storage allocation and Algol-like block structures.

T.L. MAGNANTI, "A Linear Approximation Approach to Duality in Nonlinear Programming."

Linear approximation and linear programming duality theory are used as unifying tools to develop saddlepoint, Fenchel and local duality theory. Among results presented is a new and elementary proof of the necessity and sufficiency of the stability condition for saddlepoint duality, an equivalence between the saddlepoint and Fenchel theories, and nasc for an optimal solution of an optimization problem to be a Kuhn-Tucker point. Several of the classic "constraint qualifications" are discussed with respect to this last condition. In addition, generalized versions of Fenchel and Rockafeller duals are introduced. Finally, a shortened proof is given of a result of Mangasarian and Fromowitz that under fairly general conditions an optimal point is also a Fritz John point.

T.L. MAGNANTI, "A User's Guide to MPL/T.1", (with G.B. Dantzig and S.F. Maier).

Mathematical Programming Language (MPL) is a high level programming language designed for use as a teaching and research tool in Mathematical Programming. A subset of the fall language, described here, has been implemented via a P41 translator. It includes matrix and vector notations as well as certain set like indexing capabilities. A working version of the simplex method is presented as an illustration.

T. L. MAGNANTI, "Complementary Bases of a Matroid".

Let $e_1, e_1', e_2, e_2', \ldots, e_n, e_n'$ be the elements of matroid M. Suppose that $\{e_1, e_2, \ldots, e_n\}$ is a base of M and that every circuit of M contains at least m+1 elements. We prove that there exist at least 2^m bases, called complementary bases, of M with the property that only one of each complementary pair e_j, e_j' is contained in any base.

We also prove an analogous result for the case where E is partitioned into $E_1, E_2, \ldots, E_n$ and the initial base contains $|E_j| - 1$ elements from partition E_j.

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Addendum to: Management Science Group Abstracts
1972-73

Date: August 27, 1974

Due to an inexplicable lapse in an ordinarily impeccable administrative system, Jerry Shapiro's abstracts were omitted from the Management Science Group Abstracts. Corrective pages are attached.

METHODOLOGY: Mathematical Optimization

We present here an exact decomposition method for computing penalties which makes it possible for most of the columns of a given IP problem to be kept in secondary storage and evaluated in a core one at a time. Carried to the extreme our procedure will, without a branch and bound search, reduce the original set of activities to a set of optimal activities for the IP problem, and indicate their optimal non-negative integer levels. It would appear, however, that the method would best be combined with some branch and bound algorithm.

J.F. SHAPIRO, Constructive Duality in Discrete Optimization, (with M.L. Fisher), M.I.T. Sloan School of Management Working Paper No. 625-72, November, 1972. Also, University of Chicago Center for Math Studies in Business and Economics Report No. 7321, April, 1973.

The purpose of this paper is to consolidate and extend advances in the use of mathematical programming duality theory in discrete optimization. In particular, meaningful dual problems have been identified for the integer programming problem, the resource constrained network scheduling problem, and the traveling salesman problem. The solution techniques developed to exploit the structure of these dual problems are similar and may be applied to a general class of discrete optimization problems.

J.F. SHAPIRO, Computational Experience with a Group Theoretic Integer Programming Algorithm, (with G.A. Gorry and W.D. Northup), Mathematical Programming, Vol. 4, pp. 171-192, April, 1973.

This paper gives specific computational details and experience with a group theoretic integer programming algorithm. Included among the subroutines are a matrix reduction scheme for obtaining group representations, network algorithms for solving group optimization problems, and a branch and bound search for finding optimal integer programming solutions. The innovative subroutines are shown to be efficient to compute and effective in finding good integer programming solutions and providing strong lower bounds for the branch and bound search.

METHODOLOGY: Mathematical Optimization

T.L. MAGNANTI, On the Number of Latent Subsets of Intersecting Collections, (with D.J. Kleitman), OR 012-72, October 1972.

Given two collections F_1 and F_2 of sets each member of one intersecting each member of the other, let the collections of latent sets F_i^L $i = 1,2$ consist of the sets that are contained in members of F_i but that are themselves members of F_i. If lower case letters indicate the size of the collections we then have

$$f_1^L f_2^L \geq f_1 f_2 .$$

This result is used to prove that a self-intersecting subfamily F of a simplicial complex G having the property that any element of F contains s_1 or s_2 can be no larger than the lesser of the number of elements of G containing s_1 and the number containing s_2. Certain extensions and a related conjecture of Chvátal are described.

METHODOLOGY

3. Information Systems

S.E. MADNICK, Application and Analysis of the Virtual Machine Approach to Information System Security and Isolation, (with John J. Donovan), SSM Working Paper 648-73, March 1973, and Proceedings of the ACM Workshop on Virtual Computor Systems, Harvard University, March 26-27, 1973.

Security is an important factor if the programs of independent and possible malicious users are to coexist on the same computer system. In this paper we show that a combined virtual machine monitor/operating system (VMM/OS) approach to information system isolation provides substantially better software security than a conventional multiprogramming operating system approach. This added protection is derived from redundant security using independent mechanisms that are inherent in the design of most VMM/OS systems.

S.E. MADNICK, "Program Parallelism Based upon Computation Schemata" (with Hoo-min Toong), Proceedings of the 6th International Congress on Cybernetics, 1972.

In order to attain increased computation, it is often necessary to use multi-processor systems. This requires the cooperative asynchronous execution of a program. In order to explore the characteristics of such programs, a language was developed (based upon the computation schemata approach) that accepts elementary data flow graphs along with the corresponding operator precedence graph.

The actual association of particular transformations with operators of the schema constitute the interpretation of the schema. This interpretation consists of a value set V(m) for each memory cell $m \in M$, and for each operator a function f: $V(m_1) \times V(m_2) \times \ldots \times V(m_n) \rightarrow V(n_1) \times V(n_2) \times \ldots S\ V(n_p)$ where $(m_1, m_2, \ldots, m_n)$ and $(n_1, n_2 \ldots, n_p)$ are the input and output cells associated with the operator.

S.E. MADNICK, Recent Technical Advances in the Computer Industry and Their Future Impact, SSM Working Paper 645-73, February 1973.

This article highlights major advances in the areas of technological cost/performance, computer system architecture, and steps toward meeting the requirements and capabilities of the user. The decreasing costs coupled with increased performance of computer hardware are highlighted. Recent work on intelligent data base systems and natural language interaction with the computer are also explored.

METHODOLOGY: Information Systems

S. E. MADNICK, Storage Hierarchy Systems, Project MAC Technical Report MAC-TR-107, April 1973.

The relationship between page size, program behavior, and page fetch frequency in storage hierarchy systems is formalized and analyzed. It is proven that there exist cyclic program reference patterns that can cause page fetch frequency to increase significantly if the page size used is decreased (e.g., reduced by half). Furthermore, it is proven in Theorem 3 that the limit to this increase is a linear function of primary store size. Thus, for example, on a typical current-day paging system with a large primary store, the number of page fetches encountered during the execution of a program could increase 200-fold if the page size were reduced by half.

The concept of temporal locality versus spatial locality is postulated to explain the relationship between page size and program behavior in actual systems. This concept is used to develop a technique called the "tuple-coupling" approach. It is proven in Theorem 5 that when used in conjunction with conventional hierarchical storage system replacement algorithms, tuple-coupling yields the benefits of smaller page sizes without the dangers of explosive page fetch activity.

Consistent with the results above and by generalizing conventional two-level storage systems, a design for a general multiple level storage hierarchy system is presented. Particular algorithms and implementation techniques to be used are discussed.

METHODOLOGY

4. Planning and Control

J. DERMER, Cognitive Characteristics and the Perceived Importance of Information, SSM Working Paper 618-72, October 1972.

Recently, several accounting studies have made use of concepts and relationships from the field of cognitive psychology. For example, Ijiri, Jaedicke and Knight employed the notion of functional fixation to describe an individual's adaptiveness to a change in accounting process. Similarly, Livingstone referred to learning sets in explaining why some utilities were slow in adjusting to accounting changes. In addition, Revsine employed the conceptual abstractness construct to speculate on its possible moderating effects in an experimental situation, and on its significance with respect to information overload. Yet, despite this interest in relationships between cognitive factors and information usage, little empirical study has been done of the role that cognitive factors may play in accounting.

Of particular interest to accountants is the possibility that the cognitive characteristics of an information user may affect his perception of what information is important and hence, may affect how information influences his ultimate behavior. There is considerable support in the psychological literature on human information processing for the existence of such relationships. For example, Schroder et al cited three studies of game playing by teams whose members differ in their level of conceptual abstractness. Driver related the source of the information used in playing a game to the conceptual structures of the team members and found that cognitively simpler subjects relied more heavily on information handed down by an external authority. Similarly, Terhune and Kennedy reported that teams whose members were complex showed more reliance on conceptual information than did simple subjects, who preferred concrete data. Tuckman investigated the amount of information used and found that conceptually complex groups were more likely to seek out information which was not immediately available in their environment than were simple groups. Consistent with this result is the finding of Long and Ziller that an open-minded, non-dogmatic person is likely to seek more information than a dogmatic person. Based on these results, it appears that information usage is an idiosyncratic or subjectively determined process and that relationships are of potential significance to accounting researchers. However, because of the psychological research on information processing has been performed in the laboratory, in a non-administrative context, and using students as subjects, the applicability of these results to the situations accountants are concerned with is subject to question.

This paper describes a field study in which the applicability of some of these findings to the administrative information system domain was investigated. The objective of the study was to determine if the cognitive characteristics of a manager affect his perceptions of what information is important to performing his job role.

METHODOLOGY: Planning and Control

J. DERMER, Differential Effects of Cognitive Complexity on the Organization of Management Information, SSM Working Paper 615-72, October 1972.

Recently there has been extensive research into how individuals process information by psychologists (Sieber and Lanzetta, 1964; Karlins and Lamm, 1967; Schroder et al,1967) and management scientists (Bettman, 1971; Howard and Morgenrath, 1968; Cravens, 1970). Yet, despite the scope and intensity of this general effort, little is known about how managers differ in the ways they prefer their information be organized. One characteristic that has been successfully used to differentiate several other aspects of an individual's information handling is the complexity of his conceptual structure (Schroder et al, 1967). Individuals who are cognitively complex have been found to differentiate more aspects of their environment and to track information that is not readily available when playing a management game. They have also been found to integrate more discrepant information than have cognitively simpler subjects (Schroder et al, 1967, Chapter 8). It is therefore possible that conceptual structure may also be a determinant of how managers prefer their information to be organized and hence may be an individual difference of significance to accountants undertaking the design of reports for managers. The purpose of this study is to evaluate this possibility by examining the relationship of cognitive complexity and information organization.

METHODOLOGY

5. Other Methodological Research

M.R. SERTEL, Equilibrium Existence Results for Simple Economies and Dynamic Games, (with Paul R. Kleindorfer), SSM Working Paper 631-72, December 1972.

The purpose of this paper is to bring some simplicity and generality to the investigation of equilibrium existence in certain "simple" dynamic games. The way we deal with these objects is, essentially, by reducing them to what we term "simple economies", these latter being, from the viewpoint of equilibrium existence results, at once more general and less cumbersome. In §1, we exhibit some topological facts about a certain rather general class of simple economies, including the fact (1.7, Main Theorem) that they each possess a non-empty and compact set of equilibria. Then, in §2, we define the simple dynamic games of interest, immediately reducing them (2.5, Reduction Lemma) to the simple economies studied. In §3, we show (3.0) that the simple dynamic games in question have non-empty and compact sets of equilibria, using the fact (1.7) that the simple economies to which they reduce have such sets of equilibria. We then illustrate by example (3.3) that a general class of discrete-time, deterministic games with convex performance criteria is covered by the equilibrium existence results just described. This class includes dynamic games for which certain non-linearities in the next-state map are allowed, and for which controls are restricted to compact regions, these regions themselves varying as a function of state. Of course, we do not intend that results particularized to this quite special example be understood as the main thrust of the paper.

Historically, the study of the existence of (competitive) general equilibrium in economies exhibits quite a long-standing and extensive literature. A crucial turning point in that literature is afforded by the Arrow and Debreu [1954] study, benefiting from Debreu's [1952] earlier investigation and using a FPT (fixed point theorem) of Eilenberg and Montgomery [1946]. This work is generalized in [Sertel, 1971] by use of the more powerful FPT's of [Prakash and Sertel, 1971]. Essentially, our present results can easily be demonstrated as corollaries to this last mentioned, but owing to the relative inaccessibility of both this work and the fixed point theory it employs, we restrict ourselves here to what can be done by using the relatively well-known FPT of Fan [1952] which [Prakash and Sertel, 1970] generalizes. Even with these handicaps, our main theorem generalizes the Arrow and Debreu [1954] equilibrium existence result.

We work in locally convex spaces. Such spaces include normed spaces and the conjugate space of the Banach space of all real-valued continuous functions on a given compact space. This conjugate space, in turn, is the natural habitat of probability measures under the weak (or w*) topology (see Parthasarathy [1967]). Our working in locally convex spaces is motivated by the hope and conjecture that equilibrium existence results for stochastic dynamic games may also be obtained by reducing them to the simple economies introduced here.

METHODOLOGY: Other Methodological Research

M.R. SERTEL, The Fundamental Continuity Theory of Optimization on a Compact Space I, SSM Working Paper 629-72, November 1972.

Optimizers on a compact feasible region are abstractly specified and, as set-valued mappings, are studied for sufficient conditions yielding them (as well as certain associated maps and certain restrictions of all these) continuous, using function space methods. In particular, the study concerns the continuity of the set of optimal solutions as a function of the three arguments: (i) objective function used, (ii) an incentive (or "penalty/reward") function imposed, and (iii) an abstract "parameter". An interpretation of the mathematical apparatus is suggested and a brief game-theoretic illustration given.

Abstracts of Theses

Supervised by Faculty of the

Management Science Group

1972 - 73

EXAMINATION AND MODELING OF A
PROTOTYPE INFORMATION SYSTEM

BY

RICHARD CARL AKEMANN

SUBMITTED TO THE ALFRED P. SLOAN
SCHOOL OF MANAGEMENT ON MARCH 19, 1973
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE

Abstract

Management Science continues to be plagued by a lack of generalized models for management information systems. We have models for other computerized functions: compilers, assemblers, and operating systems; but we have no generalized model for information systems.

This paper takes one information system, Janus, developed at the Cambridge Project at MIT, and using it as a prototype, adds certain features to create a more powerful, sophisticated information manager. The paper finishes with a revised model of Janus and extrapolates from this to propose a model for a generalized information system.

The paper concludes acknowledging the trade-offs between speed and efficiency on the one hand and power and flexibility on the other, but offers documentation that the trade-offs can be reasonably successfully managed for the general case.

Thesis Supervisor: Stuart E. Madnick

Title: Associate Professor of Management

THE MEASUREMENT OF HETEROGENEOUS SEMANTIC, PERCEPTUAL AND PREFERENCE STRUCTURES

by

Yvan Allaire

Submitted to the Alfred P. Sloan School of Management on August 23, 1973, in partial fulfillment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

The focus of this research is the quite simple notion that a person's affective response to an object is some function of the cognitive, or perceptual, structure harbored by that person for that category of objects.

The objective of the thesis is to propose and test a methodology for the measurement of all elements in this process (perceptual structure, affective response and the functional relationship between the latter and the former) in the context of choice among social objects. A critical examination of the theoretical and empirical foundations of the semantic differential, multidimensional scaling of similarity judgments and Kelly's role repertory test led to the articulation of a set of premises for a measurement methodology:

1. The pertinent lexicon and repertoire of constructs for a particular class of stimuli should be obtained by the systematic tapping of the constructs used by a sample of subjects drawn from the target population.

2. People may vary as to which constructs constitute markers for a particular dimension. This occurrence has been termed heterogeneity of semantic structures.

3. Measurement should be limited to the stimuli which are familiar to a subject (stimuli which are part of their relevant set).

4. People may vary as to the position they assign to the various stimuli on the dimensions underlying their perception. This has been termed heterogeneity of perceptual structures.

The examination of the preference models used in different research areas led to the articulation of a fifth premise:

5. A set of plausible preference models should be evaluated to determine which one may represent the best linkage of perception to preferences in a particular context.

A methodology consistent with these premises is proposed and tested on the choice process for brands of beer in a sample of French Canadian college students. The results indicate that the methodology provides sensitive measures of perception, preference and the linkage between them.

The extensive tests carried out support most of the premises of this methodology. Specifically, the following main conclusions were reached:

- Constructs obtained from subjects are substantially different from those obtained from managers and provide a somewhat better fit to preference data.

- The evaluation of brands in subjects' relevant sets is based upon a semantic structure of higher dimensionality than the evaluation of brands not in subjects' relevant sets.

- There is evidence of systematic variation in the pattern of inter-construct correlations among the groups identified as harboring different semantic structures. However, these differences are not statistically significant nor does heterogeneity of semantic structures have a significant impact on the goodness of fit of preference models.

- The measurement of semantic structures by a direct method leads to results substantially at variance with those obtained with an indirect method (the factor analysis of correlations between constructs).

- A global test of the impact on the goodness of fit of preference models of the various sources of heterogeneity considered in this research indicate that whether the estimation is done for each subject or for a whole group of subjects is of major importance. Heterogeneity of perceptual structures has the next largest impact followed by preference models. Overall, the best preference model turns out to be the quadratic model.

- There are substantial inter-subject variations as to which model provides the best fit to preference data.

Thesis Supervisor: Alvin J. Silk

Title: Associate Professor of Management

AN ANALYSIS OF COMMUNICATION MIX MODELS FOR THE ETHICAL DRUG INDUSTRY

by

Ilyas Bayar

Submitted to the Alfred P. Sloan School of Management on January 19,1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This paper develops alternative models to analyze the response of the ethical drug market to a communication mix. Of special interest are the carry-over effects observed in the response over time of market share to the different communication mix items. Non-linear distributed lag models using 2nd and 3rd order Pascal probability distributions to impose a specific structure on the data are developed and applied.

Thesis Supervisor: Alvin J. Silk
Title: Associate Professor of Management Science

DESIGN OF A MAN-MACHINE DECISION SYSTEM FOR A PRODUCTION SCHEDULING PROBLEM

by

Thomas Delp Blount

Submitted to the Alfred P. Sloan School of Management and the Department of Mechanical Engineering in August 1973, in partial fulfillment of the requirements for the degrees of Master of Science in Management and Master of Science in Mechanical Engineering.

ABSTRACT

The aim of this thesis is to discuss the design and development of a man-machine decision system (MMDS) which is intended to aid members of middle management in analyzing and examining alternative production schedules. The MMDS developed is used weekly by production controllers in determining the mix and amounts of piecework production which are to be scheduled for the multiple factories of a Boston-based shoe company. Issues in MMDS design taken from a literature survey are presented, followed by a suggested design methodology. The methodology is a model-based decision-centered approach consisting principally of the development of three models -- a normative model of the decision task, a descriptive model of the decision environment and task, and a functional model based on the noted differences between the normative and descriptive models.

A MMDS is defined as a system made up of three interacting components: a decision maker, an interactive computer system, and a decision task. This is meant to include only those computer support systems which are highly interactive and are designed to aid with relatively complex and unstructured decisions.

The issues in MMDS design involve many diverse disciplines, and no concise body of MMDS theory currently exists. The design methodology suggested is partly based upon a literature survey of the several disciplines directly impacting MMDS design. The methodology is applied to the design of a MMDS for a production scheduling problem.

The problem is a quite complex and unstructured one, involving scheduling of shoe patterns in multiple factories over varying production times. Each factory employs up to 1000 semi-skilled crafts which work on a piece-rate basis. The MMDS seeks to aid middle managers in their determination of the final production schedule, based upon the projected labor requirements in all crafts for each factory. A description of the MMDS is presented along with examples of system use.

The general results from the design and use of the system suggest: (1) that the decision-centered design methodology is appropriate for MMDS, (2) that MMDS can be successfully designed to aid middle managers in complex and unstructured problem areas, and (3) that MMDS provide a new and powerful means for bringing the computer directly to impact management in solving heretofore non-computerized problems.

Thesis Supervisors:	David Ness	Thomas Sheridan
Titles:	Associate Professor of Management	Professor of Mechanical Engineering

A DECISION-ORIENTED MANAGEMENT INFORMATION SYSTEM IN A NAVAL SHIPYARD

by

PETER B. BOWMAN

ROY I. NEWTON

Submitted to the Alfred P. Sloan School of Management on January 24, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

A management information system for use in the Production Department of a Naval Shipyard has been developed using the model-based decision-oriented systems design approach of Rockart, Gerrity and others. The Boston Naval Shipyard, Charlestown, Massachusetts, was used for the descriptive model. Where possible, the existing standard shipyard MIS was retained and included in the design.

The management information system design process has been broken down into three discrete segments:

a. Systems analysis--construction of normative and descriptive models.

b. Determination of system requirements--comparison of the normative and descriptive models to determine system requirements.

c. System development--development of a system to accomplish the requirements developed above.

After a brief shipyard orientation period, construction of the normative model was begun. For the descriptive model, three levels of management within the Production Department of the Boston Naval Shipyard were observed: foremen (first-line supervisors), the Repair Officer, and the Production Officer (department head). The observation period consisted of approximately one and a half months of close, daily contact with the managers involved. The decisions of these managers and information relating to them were recorded and later analyzed and categorized. After comparison of the normative and descriptive models to determine the information system requirements to support the decision categories for the managers, an MIS was designed to satisfy these requirements.

The authors have demonstrated the usefulness of the model-based, decision-oriented approach applied to the shipyard job shop environment, have proposed significant changes to the system currently in use in the naval shipyards, and recommend that potential application areas for the model-based, decision-oriented approach (i.e., other than job shop) be investigated.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

THE ACCOUNTING ISSUE OF INCOME RECOGNITION IN THE RETAIL LAND DEVELOPMENT INDUSTRY

By George J. Carmichael III

Submitted to the Alfred P. Sloan School of Management
on October 15, 1972, in partial fulfillment
of the requirements for the degree of
Master of Science in Management

Abstract

An examination is made of accounting practices related to recognition of periodic income in the retail land development industry. Reasonable and meaningful conclusions have been reached, and the proposals are given concerning alternative accounting policies for the recognition of income. Careful study was undertaken of the industry's historical background and the nature of its varied business activities. Theoretical analyses of the criteria for income recognition also contributed to the conclusions reached.

It is appropriate in the retail land development industry to postpone recognition of recorded revenues because of future development obligations and financing services associated with long-term installment contracts. This is the most reasonable method presenting periodic income under the special circumstances within this industry.

A portion of net sales revenues should be deferred for proper recognition in the future as improvements are made and the earning process is completed. Valuation discounting to present value of long-term installment contract receivables is appropriate under Opinion No. 21 of the Accounting Principles Board. The discount is then amortized as interest income over the term of the contract receivable.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

ABSTRACT

THE IMPACT OF SOCIAL ISSUES
IN THE BANKING INDUSTRY

by

Richard A. Chesney

Submitted to the Alfred P. Sloan School
on May 11, 1973 in partial fulfillment
of the requirements for the degree of
Master of Science of Management.

More and more corporations are coming under increased pressure to respond to social issues. Since they are inexperienced, their responses will go through some sort of evolution as they learn more about the problem. This thesis tries to study that process in order to gain insight into the difficulty of managing corporate social responsibility. To fully understand the problem, a case study is the most appropriate form of investigation, and chosen for study was First Pennsylvania Banking and Trust Company, now the major subsidiary of First Pennsylvania Corporation.

Through a series of interviews with numerous key individuals in the bank and from a search of various publications, it was possible to study the different corporate responses to social issues individually. From this investigation, the impact of social issues was intently observed. It was felt on two levels in the bank - in the way it does business and in the way it organizes to do business.

This breakdown also distinguishes between the limited range of applicability of First Pennsylvania's functional experience to banks and the broader scope of its organizational experience to all corporations. On an operational level, the lessons were twofold. First, the bank must sensitize its employees to the problems of dealing with Blacks as employees and as customers. Second, the bank must re-evaluate its operating procedures such as personnel standards, credit criteria, and repayment schedules, to accommodate the Blacks. For managing social responsibility in general, there are three management issues which are essential: information, organization, and evaluation. Social involvement will increase the informational needs of the organization. The organizational mechanism which will manage this involvement will vary in size according to the degree of

involvement on the particular issue. As currently designed, most firms' management systems are not able to handle social involvement. Changes are needed in the goal setting process, the performance evaluation, and the reward system. From these general conclusions, guidelines were developed to help other corporations get socially involved.

Thesis Supervisor: Gordon F. Bloom

Title: Senior Lecturer of Management

ABSTRACT

THE MANAGEMENT FUNCTION
IN PUBLIC HIGHER EDUCATION
IN MASSACHUSETTS
by
LESLIE M. CLIFT
B.A., University of Colorado
(1969)
SUBMITTED TO THE ALFRED P. SLOAN SCHOOL OF MANAGEMENT
ON JUNE 25, 1973 IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE

The management function in Massachusetts public higher education is accomplished through negotiation, bargaining, and compromise among the participants. The substance of management is a series of policy statements issued by the various participants, either singly or in unison, over time. This paper, first, looks in depth at the various structures and functions within higher education to determine the critical decision-making bodies. The various activities are classified. Then, the system is viewed in the dynamics of a policy process. A new mechanism for problem resolution is identified.

This paper relies most heavily on my own observations supplemented by the insights of several system participants. A combination of various theories provided the framework to which these observations cling; finally, documents filled in missing portions.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

THE MARKETING OF ADAPTIVE HOUSING TO THE PHYSICALLY HANDICAPPED

Jeffrey L. Cooper

Submitted to the Alred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

Many Americans are unable to move about as freely as they wish. They suffer some degree of mobility impairment due to a variety of causes - ranging from severe spinal cord injury to simply "old age". As a result of these mobility limitations, conventional housing becomes unsuitable for these persons. Stairways become barriers. Storage space becomes inaccessible. Kitchens become hazardous to use, and bathrooms sometimes become unusable. Consequently these persons are in dire need of housing which responds to them in a more human way; housing which accomodates their particular disabilities.

This is adaptive housing.

The design of adaptive housing is itself an infant field. The marketing of adaptive housing is virtually unprobed.

This study, as an initial one in the marketing area, attempts firstly to explore the size and nature of the disabled market. Secondly, it tries to develop techniques for establishing communication and distribution channels with the market. Lastly, it explores the availability of funds to the market.

The conclusions reached by the study were the following:

1) Firstly, the disabled market is largely a segmented and inaccessible one. Conventional means of communication, sales and distribution will simply not work for them. A successful marketing system will have to establish intermediary liaisons with the market through the medical professionals in the field of rehabilitation, as well as through the existing organizations of the handicapped.

2) The disabled market is a predominantly low income market. At the same time, the products developed for it being prototypical, are costly. This disparity will necessitate the extensive use of third party funding.

3) The availability of third party funding will depend in part upon the acceptance of a new definition of "Rehabiiitation". This new concept will entail the total self adjustment of the disabled person to the daily activities of the home and community environment.

Thesis Supervisor: John U. Farley
Title: Visiting Professor

AN EVALUATION OF THE EFFECTS OF CONTAINERIZATION ON THE PORT OF BOSTON

Raymond F. Coulombe

Submitted to the Alfred P. Sloan School of Management
on May 11, 1973
in partial fulfillment of the requirements for the
degree of Master of Science.

ABSTRACT

It is being argued with increasing vigor by the authorities of the Port of Boston that the introduction and development of the concept of containerization has been the salvation for this port of decreasing prominence. The purpose of this thesis is to examine this contention in light of the historical development of the container facilities of the major East Coast container ports.

A brief introduction to the concept of containerization itself is first presented. The process of containerization is explained, a sample of containerizable commodities listed, and typical growth patterns of containerized tonnage for selected ports illustrated.

The growth of container facilities for the major East Coast ports, New York, Boston, Halifax, Hampton Roads, Baltimore, and Philadelphia, is then considered. After a summary of annual additions to facilities of these ports, in terms of number of cranes and of linear feet of berth space, the growth of annual containerized tonnage for these ports is examined. Three phases of growth are identified; these are initial growth, rapid intermediate growth, and steady-state trend.

For the ports of Boston, Halifax, Hampton Roads, and Philadelphia, a regression analysis is conducted to explore the first two phases of container growth. Area berth space excluding that in the port being studied (net area space) was found to be significant in a multi-variate regression also including port berth space and GNP for all ports except Hampton Roads. GNP was significant for Hampton Roads and for Philadelphia. (Significance was at the 1% level.) It is hypothesized that an awareness factor, i.e., manufacturer awareness of the desirability of shipping containerized, increases with the development of container facilities, prompting an increase in annual containerized tonnage.

A transportation model for the third phase is proposed for the purpose of providing a basis for further study of this phase as it unfolds.

It is concluded that the Port of Boston, although late in the development of its container facilities, made a basically sound decision in initiating these facilities. However, it must carefully assess the future demands to be placed upon these facilities in order to insure sufficient capacity to meet these demands. In addition, it must strive to make the port more attractive to shippers and manufacturers alike.

Thesis Supervisor: Thomas L. Magnanti
Title: Assistant Professor of Management

HEALTH MAINTENANCE ORGANIZATIONS IN FRANCE: AN APPRAISAL

by

Jacques Charles Cremer

Submitted to the Alfred P. Sloan School of Management in June, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

For a number of years the Health Maintenance organizations have been considered in the U.S. as part of the solution of the "health care crisis." This thesis examines the opportunities for development of such organizations in France. It studies their potential impact both on the financial and medical performance of the French health system.

After two chapters describing respectively the French health system and the American H.M.O.s a model is proposed to explain the inflation in the cost of medicine in France. This model also provides insights on the determinants of the quality of care.

H.M.O.s are then introduced in this model. It is possible to derive some requirements they must meet and to determine what their impact could be.

This analysis leads to the conclusion that experiments should be conducted in well-selected communities.

Thesis Supervisor: Leon S. White

Title: Senior Lecturer

ABSTRACT

The concept of offshore manufacture of electronic components by American companies so as to save on labour costs has been prevalent since early fifties. The first half of this thesis is a general background which describes the extent of offshore manufacture, most favoured locations for foreign operations and India's attempts to establish a free trade zone to attract foreign companies. The advantages inherent in setting up a facility in the new Santa Cruz Free Trade Zone, Bombay and the incentives offered by the Indian Government have been discussed.

The second half of the thesis is a case study of the author's attempts to seek a joint venture with an American company in the Santa Cruz Free Trade Zone. The criteria for identifying the ideal products and the ideal joint venture partner have been discussed in detail. The negotiations between Circuits Inc., a Boston based manufacturer of printed circuits, and the author which resulted in an agreement to set up a joint venture in the Santa Cruz Free Trade Zone, have been discussed in the last two chapters of the thesis. Based on the author's limited experience, recommendations are made which could perhaps make the process of seeking such a joint venture easier in the future.

A CASE STUDY:

FOREIGN STEEL, DOMESTIC STEEL, A COMBINATION?

by

Jerry D. Davis

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the Degree of Master of Science.

ABSTRACT

Relative to a specific company's characteristics, this paper attempts to clearly define and understand the inter-workings and attitudes of both the foreign and domestic steel suppliers. It further conducts an actual cost-benefit analysis for the year 1972 concerning the specific company involved. Written and verbal communications with two domestic suppliers and two foreign suppliers coupled with actual data taken from the company itself provide almost all the source information.

It was concluded that the company involved saved a substantial amount of money by buying foreign steel in 1972. It was further observed that early in 1973 certain events (devaluations, world-wide peak demands, etc.) would certainly disrupt the environment in which this particular company was accustomed to.

Thesis Supervisor: Arnaldo C. Hax

Title: Associate Professor of Management Science

Trends in the Foodservice Industry

by

Noel Ellis Dill

Submitted to the Alfred P. Sloan School of Management
on January 24, 1973
in partial fulfillment of the requirements for the
degree of Master of Science

This thesis was a study of the available statistical data relating to the Foodservice Industry in the U.S. The purpose was to examine this information in an effort to identify the recent historical trends which have affected this industry, and having done so, to analyse and compare these trends with the perceptions of managers in the field. Further, the reactions and future plans of these managers were evaluated.

The information discussed was gathered from two sources: association newsletters, government publications, and other industry reports were utilized for the initial trend identification, and interviews with ten managers of large, quality restaurants in the Boston, Massachusetts area were the source of the perceptions discussed in the final section.

The study showed two major trends in the industry: There are increasingly frequent tendencies toward the establishment of chains and other large scale foodservice operations, and the foodservice itself is moving in the direction of fast food and fast service operations.

Generally, the foodservice industry is beset by labor problems and a lack of technology. There is very little research of substantial import being done. The efforts of improvement by managers are directed toward the margin of existing concepts, with little or no innovation.

Thesis Supervisor: Gordon F. Bloom

Title: Senior Lecturer of Management Science
Alfred P. Sloan School of Management

ABSTRACT

Our nation faces a serious shortage of public recreational opportunities along the coastal shoreline. This shortage has materialized as a mushrooming demand for the unique and relatively scarce resources of the coastal environment has far outstripped the effective supply. A pattern of economic growth and private development in coastal areas has continued unchecked for the past three hundred years, so that now we find only a small percentage of the entire shoreline in public hands for recreation. Furthermore, the problem is compounded by pollution, erosion, and the increasing tendency of private owners to restrict access in areas traditionally available for public use. But while the supply is limited, the demands increase at a breakneck pace. The multiplicative effects of increasing population, income, leisure time, and mobility are expected to bring about a tripling in the demand for outdoor recreation by the turn of the century. Yet the facilities, especially those involving water-oriented activities, are saturated now with hordes of users.

The source of the shoreline recreational problem lies in the institutional mechanisms that historically have been relied on to allocate scarce resources amon competing uses. This "allocative system" consists of the competitive private market and local governmental units, both of which, under certain circumstances, can be shown to under-represent certain important social values while over-representing others. The circumstances leading to allocative imperfection include: (1) the inability of the price system to determine and articulate the true costs and benefits to society associated with the use of common-property resources; and (2) the tendency of municipal officials to make decisions governing the use of resources of more-than-local significance solely on the basis of local needs and values. In sum, the historical organization of economic and political activity gives rise to systematic forces which, if left unadjusted, tend to misallocate resources on a large scale. This is what has happened in the coastal shoreline: public beaches and recreational open spaces have not been sufficiently provided while private development has soared; water qualtiy has not been maintained as industrial and municipal wastes have made sewers out of most estuaries; and many ecologically-important wetlands have not been protected from indiscriminate dredging and filling. At the same time, governmental action at higher levels has frequently been a classic case of too little and too late.

Recent legislation at the federal level expresses concern over the coastal resource situation —including the problem of decreasing open-space for public recreational use—and encourages the states to develop management programs to make wise use of coastal lands and waters. The search for manageable solutions to the shoreline recreation component of this broad mandate must begin with an analysis of the legal regimes governing public vs. private rights in seashore areas. As it turns out, public recreational rights in the waters, tidelands, and submerged lands of most coastal states are relatively firmly established. The larger part of the problem of public rights stems from private ownership of littoral property in upland areas, above the line of mean high tide. Since the shoreline cannot be effective as a complete

(abstract continued)

recreational resource without the availability of uplands held by shorefront proprietors, any discussion of public use must focus on the legal principles applicable to this portion of the seashore.

In recent years, progressive courts in a few states have employed a variety of common-law doctrines to confirm public recreational rights both in private and municipal areas traditionally open to use by the public at large. While judicial activity has played a significant role in calling attention to the recreation problem and stimulating legislative response, it cannot be relied on as an effective tool of public policy in the long run. The major difficulty is that reliance on judicial determination of the public interest on a case-by-case and jurisdiction-by-jurisdiction basis interjects enormous uncertainty into what should be a coherent and orderly planning process. Striking a balance among public recreation, private recreation, conservation, and other uses of the coastal shoreline is a management problem and as such is the proper domain of the legislatures and their duly-authorized administrative agents.

Since a beach is essentially an open space and a public beach a public park, the legal tools available in the formation of public policy are basically those which have been applied in the areas of open-space and recreational planning. The most direct and frequently used method of securing shoreline areas for public use is to buy them, either through purchase or condemnation of the fee simple or an easement. While government acquisition programs are the most desirable means of providing recreation facilities in the long-run, there is a need to apply more flexible legal mechanisms to preserve the open-space character of the shoreline in the short-run. If beaches and other prime recreational shorelands currently under private ownership are ever to be "reclaimed" for public use, they will have to be regulated so as to prevent construction on at least that portion of the beach most appropriate for public use, i.e. the dry sand area between the water's edge and the line of vegetation. Having examined the constitutional limitations of the regulatory power with respect to open space objectives, it seems clear that a number of land-use controls can be utilized in the shoreline situation. Exclusive-use zoning, setback lines and official mapping, subdivision exactions, compensable regulation, and tax techniques are all potentially effective means of preserving the seashore as a unique open-space resource; and carefully-drafted ordinances regulating seashore use stand a good chance of weathering constitutional storms with regards the issue of taking withou due process of law.

Decreasing open space for public recreational use is prototypical of the complexity of coastal resource management issues. This report isolates the economic and political causes of the problem and evaluates the legal techniques available to carry out public policies that are designed to solve it. But the process of making equitable and efficient choices among policy alternatives entails consideration of a wider range of practical decision-making issues, which are outlined and then consigned to future efforts.

IS PREPAID DENTAL CARE THE SOLUTION?

James J. Findley

Submitted to the Alfred P. Sloan School of Management on June 19, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This thesis is an evaluation of the potential and the record of prepaid dental care as a means of increasing the utilization, insuring the quality and controlling the cost of dental care.

Most people need to visit their dentist once a year to maintain their oral health. Yet, in a given year, less than half of the population goes to a dentist and a much smaller fraction follows a program of regular care. People who do go to the dentist find that the cost of dentistry is rising faster than the cost of most other services, and, in some cases, that the care they receive is not adequate.

All dental prepayment mechanisms stimulate utilization by reducing or eliminating the cost barrier to the individual. Furthermore, as a new force between patient and dentist, they have the potential to promote the utilization of dental care and to affect the quality and cost of the care that is given. However, they also create forces against the desired utilization, quality and cost of care.

A large part of this thesis is devoted to the development and application of standards to measure how well existing dental plans have lived up to their expectations. Overall, the available data indicates that they have indeed had a positive impact on the utilization, quality, and cost of care, but that this impact is limited in scope and is very much a function of the effectiveness of the plan's organization and implementation.

Thesis Supervisor: Glen L. Urban
Title: Associate Professor of Management.

THE CAPITAL BUDGETING DECISION

by

Charles P. Fletcher

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

The capital budgeting decision is one of the most challenging problems faced by top management of large corporations. This is particularly true within the context of capital-intense primary industry. This thesis examines the nature of the capital budgeting process within the Aluminum Company of America. It describes the nature of the prevailing investment climate and identifies some of the specific constraints that are imposed.

The mechanism of preparing the capital budget is outlined which leads into an examination of the process for evaluating alternate investment proposals. This thesis does not deal with the problem of portfolio selection or the comparison of independent proposals. It concentrates instead on the evaluation of an individual proposal.

The evaluation involves a detailed description and analysis of an existing Alcoa risk analysis program. This is a comprehensive computer operated Monte Carlo simulation which recognizes the stochastic nature of relevant sales, cost, and investment data. The operation and sensitivity of the model are demonstrated by a hypothetical example concerning equipment investment.

The outputs of the model are then evaluated and compared to current practice as described in relevant literature. The model operation and analysis highlights the problems associated with rules of thumb such as payback period, return on capital employed, and internal rate of return.

The thesis concludes that quantitative analytical analysis is an essential tool for decision making managers, but that intelligent application demands a thorough knowledge of the operation of the model.

Thesis Supervisor: Arnoldo Hax

Title: Associate Professor

A STUDY OF COMPUTER PROGRAM ACQUISITION MANAGEMENT

IN SEVERAL AIR FORCE PROJECTS

by

John Robert Gehman, Jr.

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

The United States Air Force has developed a systematic approach to the management of systems acquisitions known as the 375 Series of Manuals. This thesis examines four Air Force systems (473L, 416M, 407L, and 485L) to determine the effectiveness of these guidelines as applied to computer programs. The first three systems have been completed, while the fourth is an on-going program.

The relative success of any computer program system development is thought to depend to some degree on the nature of the management approach adopted. Each of the four systems was examined in terms of the following variables: extent of success, organizational structure, personnel selections, estimating procedures, type of contract, contractor reporting and control system, system design approach, specification development, testing, milestones, design reviews, maintenance/modification philosophy, and installation and turnover.

This study demonstrated that proper, conscientious application of the 375 Series guidelines for Air Force Systems Management should result in a greater degree of success in the acquisition of computer programs. Experience with the systems studied indicates that special attention should be focused on systems engineering, configuration management, and the logical progression of events (milestones) in the system life cycle phases.

Thesis Supervisor: Malcolm M. Jones
Title: Assistant Professor of Management

ABSTRACT

AN INVESTIGATION OF REAL ESTATE INVESTMENT SYNDICATES

Mark Gilman
Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

The objective of this thesis is to provide an evaluation of the effectiveness of real estate limited partnerships as a vehicle for channeling equity capital into real estate. After an initial discussion of the basic structure of limited partnerships, the subsequent analysis attempts to identify those features in various types of partnerships which are relevant in determining their respective investment characteristics. This will provide the necessary basis for approaching the issue of whether there is a segment of the investment community for which limited partnership shares represents an efficient investment. Establishing the fact that there is a sufficiently deep market for these securities is an essential component of the overall task. Without such evidence, it would be unrealistic to conclude that limited partnerships represent an effective vehicle for channeling equity capital into real estate.

While the first half of this thesis is primarily concerned with limited partnerships from an investor's viewpoint, the latter sections focus on the status of the general partner. Clearly, since it is the general partner who initiates the formation of limited partnerships, and thereafter manages partnership affairs, the arrangement must also be attractive from his viewpoint. This is to say that a potential general partner must be able to satisfy his financial objectives through the formation of a limited partnership. Thus, the latter portion of the analysis concentrates primarily on identifying those areas in which the general partner can improve his risk/return posture by employing this vehicle.

The completion of the aforementioned analysis then enables one to ascertain the level of effectiveness of real estate limited partnerships in drawing equity capital into real estate.

Thesis Supervisor: Gordon Bloom

Title: Senior Lecturer, Sloan School of Management

LEARNING STYLE INFLUENCE ON CAREER DECISION

by

Marshall Barrett Goldman

Submitted in partial fulfillment to the

Alfred P. Sloan School of Management on June 22, 1973

Abstract

The Learning Style Inventory was used to collect data on learning styles of seniors at MIT. Undergraduate major mean learning styles were found to correspond to predicted learning requirements. When the learning styles of careers were compared, this distribution fitted the predicted distribution. The choice of Mathematics as a career correlated significantly with above mean abstract Learning Style Inventory Score.

MULTIPLE INVESTMENT IN THE RETAIL AUTOMOTIVE FIELD

by

John O. Grettenberger

Submitted to the Alfred P. Sloan School of Management on March 1, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

A major problem faced by auto manufacturers today is the maintenance of well capitalized, well housed, and well staffed dealerships operated by individuals experienced in automobile retailing. With escalating capital requirements, the need for prime real estate locations and sophisticated service equipment, it has become increasingly difficult to secure qualified dealer candidates with the required financial support.

The purpose of this study is to examine sources of capital for dealership financing not currently being utilized by auto manufacturers, with particular emphasis on chain investment by existing dealers. The hypothesis tested is that due to a lack of understanding and clearly defined policy, auto manufacturers and potential investors among the body of current retail dealers are not making maximum use of capital resources at their disposal. In hopes that a better utilization of capital resources will result, this study critically analyzes the requirements of the manufacturer and investor with regard to both the opportunities presented and the controls required.

The research methodology consisted of a review of published literature on the subject coupled with a series of personal interviews with key individuals at General Motors Corporation, its five car divisions, field management personnel, and retail auto dealers with an interest in chain investment.

The study revealed that chain investment by existing dealers can be a healthy means of securing capital for new and expanded dealership operations provided that the requirements of both the manufacturer and investor are considered in policy implementation. Changes in manufacturer attitude towards chain investment, their current policy, and administrative procedures are essential, however, before expansion of chain investment takes place.

Thesis Supervisor: Gordon F. Bloom
Title: Professor of Management

A STUDY OF FIRST-TIME BLOOD DONORS

by

Alexandre J. Gros

Submitted to the Alfred P. Sloan School of Management on June 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

It would appear that a considerable fraction of first-time blood donors do not continue to donate regularly. A deeper understanding of this phenomenon is a prerequisite to evaluating the cost/effectiveness of directing efforts towards increasing the flow of first-time blood donors as opposed to improving the retention of former donors.

We have developed a methodology and undertaken a small pilot study for learning about the factors which dispose or inhibit people towards blood donation. Our emphasis is on the development of a workable methodology for learning about the decision processes of first-time blood donors. This thesis focuses upon the study of (1) the reactions of these donors to their initial blood doning experience and of (2) their present attitudes towards giving blood. After choosing a possible conceptual framework from the literature of Social Research to develop a 72 item questionnaire, a survey was conducted by means of face-to-face interviews with a sample of 48 recent first-time donors in Newton, Massachusetts.

Our primary conclusions are methodological. We provide a framework for structuring our survey instrument and for analyzing responses to it. We suggest improvements in the instrument, discuss general interviewee reactions to the administration of the questionnaire, and suggest future alternatives for furthering this research on a broader scale.

However, some dominant properties of the responses may be noted here, keeping in mind the small sample and the pilot nature of this study. Respondents overall feelings about their first-time donation experience are positive. The first donation appears to dissipate initial fears and apprehensions, rather than hindering repeat donations. A shift in motives seems to occur between initial and later donations, with the insurance motive later becoming as important as the altruism which initially was the dominant motive. We did not find appreciable evidence that the first donation has a negative effect on subsequent donations. If more thorough future studies verify this, one will want to look to other factors (such as the availability of convenient, regular opportunities to give or the evolution of individuals' altruism as they get older) to account for present low donor retention rates.

Thesis advisor: Alvin J. Silk

Title: Associate Professor of Management Science

Supplementary advisor: Alvin W. Drake

Title: Associate Director, Operations Research Center

Professor of Electrical Engineering

PROFIT CENTERS AT UNITED AIR LINES AND ITS EASTERN DIVISION

MICHAEL LOUIS HENEGEN

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of

Master of Science

In December, 1970, the Board of United Air Lines took drastic action to restore the airline to profitability. They fired the president and replaced him with a man with no airline experience. The new president chose to implement profit centers as a vehicle to restore profitability. This thesis analyzes the problems in the industry and at United in 1970 and identifies the key variables for success for a firm in the industry and for United in particular. Most of United's problems were rooted in bad decisions about key variables by top management.

The thesis analyzes the profit center concept chosen by United and United's implementation in order to evaluate 1) the profit center system as being appropriate to an airline and as a solution to United's problems and 2) United's implementation as a profit center system and as a solution to United's problems. A profit center system is not appropriate to an airline because so many of the key variables must be controlled by top management that division managers have only limited control of costs and revenues. Further a profit center system cannot solve United's problems because most of United's problems were rooted in bad decisions about key variables by top management. These key variables are too important to the whole company's success to be decentralized. United's implementation recognizes this and maintains corporate control of most key variables. However, this means that division managers have control over only about 25% of costs. Thus United's implementation is not really a profit center system. The use of profit as a measure and the large scale management changes which have accompanied could be disfunctional. While United's system may be effective for motivating line managers (and top management is very enthusiastic about and committed to the system), it cannot solve the profit problems because it doesn't address the major key variables of the company.

A better alternative than profit centers for restoring profitability would be the strengthening of central staffs in order to provide top management with better information and analysis for making key decisions. This would enable management to correct the bad decisions of the 1960's and to develope coordinated plans for making these decisions in the future.

Thesis Supervisor: Jerry D. Dermer
Title: Visiting Associate Professor of Management

AN EXAMINATION OF SIGNIFICANT INTERNAL GROWTH IN THE AEROSPACE CORPORATE ENVIRONMENT

by

Walter Raymond Herbert, III

Submitted to the Alfred P. Sloan School of Management on May 7, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

Aerospace corporate expansion by formation of department or division-sized significant internal growth ventures is studied through the literature and by interviews. Emphasis is placed on establishment of the venture goals, determination of the organizational structure, venture management and control, and motivation. Results are presented in each area that are based upon interviews with venture managers and/or their overseeing executive within the parent firm for six growth ventures, two in each of three anonymous aerospace firms. Contrasts are drawn with the literature in each subject area.

Thesis Advisor: Michael S. Scott Morton
Title: Associate Professor of Management

Work Relationships in the Delivery of Health Care:

An analysis of the division of labor between physicians and nurse practitioners in outpatient clinics

by

Eric L. Herzog

Submitted to the Alfred P. Sloan School of Management on August 7, 1973 in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Management.

ABSTRACT

This dissertation represents a preliminary attempt to structure the problem of division of labor between health professionals. The research has implications for the nature and organization of the work of nurses and physicians in particular and the work of other professionals in the health industry in general. In addition, the research is of relevance to the theories and empirical work on leadership, role conflict, professionalization, and job enlargement.

Focusing on the nurse-physician work relationship, the primary questions for this inquiry are the following: (1) what factors are important in determining the relative amount of the nurse's responsibility for specific health services and (2) what are the effects of the amount of the nurse's responsibility on the satisfaction of the nurse and the physician with the organization, the quality of service as perceived by the nurse and the physician, and the personal efficacy of the nurse and the physician.

Prior to ascertaining the amount of the nurse's responsibility, a representative set of adult health services performed by the nurse and the physician are identified. Then the amount of the nurse's responsibility for each of these services is determined and the extent to which several "explanatory" factors are related to the amount of the nurse's responsibility is determined. Three factors which are considered are the leadership style of the physician, the work group atmoshpere, and the amount of responsibility desired by both the nurse and physician for each of the health services. Analysis of the relationships indicates that leadership style of the physician, the nurse's rating of her work relationship with her physician coworker, and the amount of responsibility desired by the nurse are most closely related to the amount of the nurse's responsibility. Specifically, the nurse has more responsibility for certain health services when the physician's leadership style is more relationship-oriented, the nurse rates her work relationship relatively high, and the nurse desires more responsibility.

The relationships between the amount of the nurse's responsibility and the "outcome" variables are then examined. The findings indicate the following: quality of service, as perceived by the nurse and the physician, is positively related to the amount of the nurse's responsibility for a few health services; the physician's personal efficacy is negatively related to the amount of the nurse's responsibility for most of the health services, while the nurse's efficacy is unrelated; the nurse's satisfaction with the organization is positively related to the amount of the nurse's responsibility for several health services and negatively related for others, while the physician's satisfaction is unrelated to the amount of the nurse's responsibility for most of the health services.

The data were collected from twenty pairs of nurses and physicians in three ambulatory health care centers. Each pair delivers primary adult health care. A personally administered questionnaire was used to collect the data.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

COMPUTER SECURITY IN AN EDUCATIONAL ENVIRONMENT

By

Donald O'Neal Hewitt

Submitted to the Alfred P. Sloan School of Management on
May 11, 1973, in partial fulfillment of the
requirements for the degree of Master of Science

ABSTRACT

The thesis begins with a qualitative description of the educational computing environment. The environment is described as consisting of three areas -- Administration, Research, and Classroom Support. After discussing these three areas, their security requirements are examined in terms of a simple framework. An attempt is made to separate physical and operating system security requirements.

The various security requirements are compared, and it is asserted that the solution of the problems of the Classroom Support Environment effectively alleviates the problems of the other areas.

The MIT Class Monitor System, in conjunction with the IBM Resource Security System (RSS), is used as an example of a trial solution to these security requirements. In conclusion, some problems of the adaptability of current operating systems to the Classroom Support environment are discussed.

Thesis Advisor: David N. Ness
Title: Associate Professor of Management

Abstract

Planning for an Effective Hospital Administrated Emergency Ambulance Service in the City of Boston

Submitted to the Alfred P. Sloan School of Management on Oct. 25, 1972, in partial fulfillment of the requirements for the degree of Master of Science in Management.

Emergency health care and particularly emergency ambulance systems are a long neglected area of urban services. The objective of this thesis is to aid the City of Boston Department of Health and Hospitals in the planning of an "effective" hospital administrated emergency ambulance service through the development of an "effective" transportation subsystem of the ambulance system. This system is proposed not only to greatly increase the quality of service rendered but also to release almost entirely the Boston Police Department from this non-police medical function of which they were the sole purveyors until 1970.

Three measures of effectiveness are considered relevant. First, response time, the time elapsing between the occurrence of an emergency and the arrival of an ambulance with a trained medic, must be kept short. Second, because of the advantages of employing a secondary back-up service the police will respond to calls for ambulance service when no hospital ambulance is available. The amount of ambulance work the police perform should be no more than 5% of the total ambulance runs (this is defined as a 95% service level). Third, utilization, the percent of time a given ambulance is busy should be kept as high as possible without producing unacceptable results for the other two measures, since an increase in utilization decreases the cost per ambulance run.

Since variable personnel costs are the major cost consideration, the important question for the transportation subsystem is not how many ambulance vehicles to buy but how many ambulances to man at different times of the day. Data on the present level of demand for emergency ambulance service in Boston and temporal and spatial distributions of this demand are used.

A queuing model for dual source ambulance systems (hospital ambulances, police backup) developed by Stevenson is applied heuristicially to various sized areas of the city in order to gain insight into the trade-offs involved between response time, service level, and utilizations as the number of ambulances allocated and area size changes. In some sections of the city the response time criterion is the important factor effecting the allocation level while service level or utilization is the primary factor in other areas.

An ambulance allocation policy for Boston is developed assuming the present level of demand as well as increased and decreased demand. System operation statistics (service levels, utilizations) are given.

Finally, the costs associated with implementing and operating the proposed system are considered.

Thesis Abstract

INFORMATION HANDLING IN A LOCAL GOVERNMENT PUBLIC WORKS DEPARTMENT
Myle Joseph Holley III
Submitted to the Alfred P. Sloan School of Management on February 16, 1973, in partial fulfillment of the requirements for the degree of Master of Science

Existing computer applications in the local government sector have in general been transaction-oriented. A number of authorities in the field propose that the development of comprehensive transaction systems and data bases will lead naturally to satisfaction of all management information requirements. Systems design has focused on data base issues rather than on the managerial environment.

An analysis of computer relevance in fact should begin with examination of the managerial environment. Once the key decision-making and control issues are isolated, it is then possible to identify requisite levels of information support.

In order to restrict the thesis scope, a single government function (the Public Works Department in Arlington, Massachusetts, a town of 50,000) has been selected for study. A simple model of managerial planning and control is developed (based upon two models commonly known in the management literature). When the model is applied to the Arlington PWD case, it becomes clear that the key management tasks are five: (1) allocation of resources to maintenance, (2) aggregate planning, (3) scheduling, (4) introduction of technique changes, and (5) control.

Normative approaches to each of these management tasks are suggested. When compared to existing PWD management practices, it appears that the normative approaches can lead to efficiency improvements in excess of $100,000 per year.

The information and processing elements required to support the normative management approaches can be clustered into four areas: (1) resource use accounting, (2) system (e.g., the road network) status accounting, (3) route design support, and (4) water billing. These information components can be developed manually, or with PWD-based computer assistance, or with Town-based computer assistance. The latter alternative appears to be the least-cost solution.

Thesis Supervisor: Michael S. Scott Morton
Title: Associate Professor of Management

KEY CONCEPTS IN AN INTRODUCTORY MANAGEMENT INFORMATION SYSTEMS COURSE

by

Gim Poy Hom

Submitted to the Alfred P. Sloan School of Management for the degree of Master of Science in Management.

ABSTRACT

An introductory Management Information Systems course should introduce students to the key hardware and software components of a computer system. The hardware components include tape drives, disk drives, card readers and CPU; the software components include compilers, assemblers, loaders and the operating system. These hardware and software concepts can be introduced through a simulated system such as the one used at the Sloan School of Management in its introductory Management Information Systems course.

These key hardware and software issues are discussed. A comparsion and discussion of the various philosophies for introducing these concepts in the computer courses at M.I.T. is made followed by a discussion of the advantages of using a simulated system and possible alternatives. New computer problems have been developed to illustrate more of the practical and interesting concepts of computer systems. From the improved course material, the student will gain more than a rudimentary skill in solving managerial problems with large data bases on a computer system.

Thesis Supervisor: David N. Ness

Title: Associate Professor of Management

ABSTRACT

Thesis Title: Computer Networks As A Means For Satisfying An Organization's Computer Needs

Author: Michael Steven Katz

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

This thesis discusses one approach to providing computer capabilities for an organization; computer networks. Two questions are addressed: 1) the existence question--whether an organization should create a computer network, as opposed to maintaining separate data centers or buying outside services; 2) the design question--what kind of network might be appropriate. The thesis attempts to show how the answers to these questions depend on the organization under consideration.

Chapter one defines the terminology and the scope of the problem; examples of computer networks are described. In chapter two an organization model is presented and organization characteristics relevant to the problem are defined. The issues and factors which surround the network questions are discussed in chapter three. Chapters four and five synthesize the earlier chapters, describing alternate computer options briefly and showing how organization characteristics should influence decisions on the existence and design questions.

A small opinion survey was conducted, among some practitioners in this field, to test reaction to the ideas and conclusions presented in chapters one through five. Chapter six presents the results of the survey together with our interpretations and conclusions; suggestions for further research are made.

Thesis Supervisor: Michael S. Scott Morton
Associate Professor of Management

An Analysis of the Development and Administration of Section 314(d) of the Public Health Service Act, as Amended

Richard Maurice King

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

Abstract

In 1966, legislation was passed by the U. S. Congress which consolidated nine categorical formula grants for public health programs into a block formula grant to be administered by state health departments. The programs were consolidated by Section 314(d) of the Public Health Service Act and included tuberculosis control, chronic disease services, heart disease control, cancer control, mental health services, dental health services, radiological health services, home health services, and general public health services. The primary purpose of the consolidation was to give the states more flexibility in the administration of their health programs.

This study of the 314(d) legislation is of interest because it caused the evolution of a program which closely resembles President Nixon's proposals for special revenue sharing. The thesis reviews the 314(d) legislation to determine the original goals and objectives, analyzes the administration of the program during its six year history, evaluates the extent to which 314(d) has met its goals and objectives, discusses the program within the framework of block grants and special revenue sharing, and makes some recommendations for the administration of Federal programs which are similar to the 314(d) program. Data for the thesis was obtained from a review of printed materials and a series of personal and telephone interviews with state and Federal officials.

It is concluded that the 314(d) program closely resembles special revenue sharing and that Federal control of the program has been minimal. The program has provided the states with more flexibility in administering public health programs. The coordination of the 314(d) programs with other "partnership for health" programs did not occur. Compliance of the 314(d) program with congressional intent and Federal guidelines and regulations has been partial in some areas. Evaluation of the program and the reporting of expenditures has been poor.

It is recommended that future legislation for block grant and special revenue sharing programs be more explicit regarding Federal and state requirements for administration.

Thesis Supervisor: Leon S. White
Title: Senior Lecturer

SIMULATION-BASED ANALYSIS OF THE COURTROOM

by

Donald B. Krasnick

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science

ABSTRACT

The problem of excessive delay in the court system has been recognized as a major area of concern in the field of judicial administration. Simply put, this comes about through an imbalance between judicial supply and the demand for court processing. Thus, various efforts have been tried in the past which aim at increasing supply and decreasing demand, through both direct and indirect means. Past efforts are analyzed initially, including court calendaring systems, information systems, increased settlements, and other demand-decreasing systems.

For the purpose of analysis of the courtroom and potential methods for curbing excess delay, a generalized, macroscopic-level simulation model of the jury trial session of the civil courts was developed using the SIMPL simulation language. The courtroom is modeled basically as three queues, which feed each other. Cases enter through the trial_list, progress to the waiting list (where different priorities may be used for entrance purposes), and finally go to individual on_call lists for each session. Statistics as to waiting times and delays, judge utilization, and number of trials processed are collected automatically by the model.

The simulation model was used to analyze the following optional methods: court calendaring systems, changing the number of backup cases, increased settlements, directly increased judicial supply, and various shortest operating time algorithms. Results indicated that most methods are ineffective due to the large imbalance between supply and demand, since they are usually aimed at incremental system improvements. They usually induced cases to "hurry up and wait". Simply adding more judges produced the best results. While the SOT rules did not work well, the model showed that sophisticated trial-time estimation schemes generally yielded marginal returns.

OPTIMAL MEASUREMENT AND POLICY DECISIONS FOR A CLASS OF VARYING PARAMETER SEQUENTIAL CONTROL PROBLEMS IN MARKOVIAN FORM A BAYESIAN APPROACH

by

THOMAS KROLIKOWSKI

Submitted to the Alfred P. Sloan School of Management on August 29, 1972 in partial fulfillment of requirements for the degree of Doctor of Philosophy in Management

ABSTRACT

The central topic of this thesis is Bayesian adaptive control. It develops a conceptual system for analysis of a certain class of sequential decision problems representable in the Markovian Form of linear varying parameter regression structures with multivariate normal probability densities. The system treats in depth each step in the modeling process and then prescribes how policy and measurement decisions should be made in a changing environment.

A general class of sequential control problems is introduced within which a desired class is defined. Classes of experiments and procedures for computation of sufficient experimental statistics are developed while the conditional probability results of Rosenberg [R3] are not only specialized to the class of interest but also extended by the additional results derived for unconditional densities. Systems concepts are introduced and quantified in terms of the state parameters of the decision process itself. The Dynamic Programming recurrence relations and the customary Decision Theoretic measures characterizing the optimal solution are obtained with the latter results used to derive bounds on the measurement decisions and the optimal value function. The question of solvability of the recurrence relations characterizing the sequential decision problems is answered with a general set of guidelines for designing an effective stage by stage solution strategy and with a blueprint of the supporting computational system.

A completely stochastic version of the adaptive promotional control problem of Little [L1] is specified and a few stages analyzed to illustrate selected methodologies and approximations.

Thesis Supervisor: Gordon M. Kaufman

Title: Professor of Management

THE STRATEGIC BEHAVIOR OF AMERICAN DEFENSE FIRMS, 1946-1971
A COMPARATIVE ANALYSIS

by

ILAN KUSIATIN

Submitted to the Alfred P. Sloan School of Management on May 1, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

Abstract

The purpose of the thesis is to compare the strategic behavior of four major and "typical" American defense firms with regard to their product-market scopes during the period of 1946 to 1971, to find out to what extent similarities have existed, and what major factors have determined their strategic behaviors. The definition and classification of strategies, the factors which trigger a change of strategy and the process of strategy choice are based on Ansoff's framework.

The main elements, which have been investigated, included the expansion and diversification of each firm's product lines and markets, its objectives, its performance, its technological and managerial capabilities, and the various aspects of the American defense environment - defense expenditures, advanced technology, Government-Firm relations, procurement and contracting policies, and competition.

The investigation has come to the following major conclusions:

a) The highly technological characteristics of weapon-systems is responsible for the predominant orientation of defense firms towards technologically sophisticated products and markets, government as well as commercial.

b) The predominant and, in some cases, the exclusive way of expanding into non-military markets has been the conversion of military products and technology into "civilian" products.

c) The desire to expand or diversify into non-government markets has been translated into actual efforts almost exclusively in periods of declining profitability and growth rates within the military market.

d) Success or failure in penetrating and maintaining position in commercial markets cannot be attributed to any "characteristic" of the "defense industry" as such, but rather to the particular strengths and weaknesses of each individual firm.

Thesis Supervisor: Michael S. Scott-Morton
Title: Associate Professor of Management

INTRACOMPANY PRICING POLICY

OF A EUROPEAN COMPANY

HAVING A SUBSIDIARY IN NORTH AMERICA

by

JEAN M. LAFFARGUE

Submitted to the Alfred P. Sloan School of Management on May 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

A European Company has decided to locate a subsidiary in North America. This North American subsidiary could be fully owned or set up as a joint venture with a local partner. Located in one of the three nations of North America this subsidiary would have commercial branches in the two other nations. The purpose of this thesis is to identify and analyze the problems encountered by the Company in setting a transfer pricing policy applicable to the transfers between the Parent Company and the North American subsidiary and between the subsidiary and its commercial branches.

The dissertation begins with an analysis of the characteristics of a transfer pricing policy and the various transfer pricing methods are successively reviewed under economic, pragmatic and mathematical approaches. The second part is devoted to an analysis of the international environment and the incidence on transfer pricing policy that various constraints like tariffs, taxes, currency fluctuations, etc... may have. The international environment analysis is followed by a study of the transfer pricing policies of some European Companies already faced with the problem of having subsidiaries in North America, and a brief comparison with United States based international firms is done. Finally, some guides are given, summarizing the main questions that a European Company with a North American subsidiary has to answer when setting a transfer pricing policy.

The various sources of information used in the preparation of this paper have been:

- Current literature and periodicals
- Personal interviews of
  - Subsidiaries of French Companies
  - Headquarters of American Companies
  - Bankers and lawyers
  - American, Canadian and French government organizations.

THESIS ADVISOR : ARNOLDO C. HAX

Title : ASSOCIATE PROFESSOR

THE IMPACT OF A CONVERSATIONAL MAN-MADE MACHINE DECISION SYSTEM ON THE PORTFOLIO SELECTION PROCESS

by

Thomas Landau

Submitted to the Alfred P. Sloan School of Management on December 18, 1972 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

The purpose of this thesis is to show how a conversational computer-driven graphical display system can aid a decision maker in a situation where the information processing requirements are complex. The portfolio selection process within the Trust Department of a large bank was chosen as the focus of the decision support system, primarily because (1) the information processing requirements of the job exceed the capacity of the unaided human, (2) key elements of the decision process are judgmental and thus the process cannot be completely automated, (3) the decision process is repetitive in nature so that the informational requirements are stable over time and (4) the financial magnitude of the decisions is such as to justify the cost of systems support.

The first chapter of the thesis discusses the theory of man-machine decision systems, reviews previous experimental work in this area, and cites relevant considerations from the experimental psychology literature. The second chapter briefly reviews the financial theory of portfolio management and explores the implications of the theory for the organizational design of a bank Trust Department. Discrepancies between the assumptions of the theory and conditions which exist in the real world are discussed in order to assess the applicability of the theory to real decision contexts and discover the additional assumptions necessary to bring the theory into line with empirical data. The possible role of an interactive computing system as an aid to operationalizing the theoretical model is discussed. The purpose of discussing the theoretical or normative model before a descriptive model of the portfolio selection process is presented is to aid in the process of problem finding, in which discrepancies between actual and desired behavior may be observed.

The third and fourth chapters are devoted to a descrip-

tion of a real world Trust Department and a series of experiments designed to capture some understanding of the process and structure of portfolio selection within that environment. The third chapter describes the Trust Department from an organizational standpoint. A short history of the department is provided and interviews with key personnel are presented in an effort to portray the background of the personnel, major job functions, communication flows, job frustrations, and attitudes toward the computer system soon to be installed. The fourth chapter discusses the design of experiments and interviews designed to elicit information regarding the construct space within which managers consider portfolios and the process by which managers revise their portfolios. Two psychological instruments designed to elicit managerial conceptual structure are described and sample data from the administration of each are presented. Hypotheses regarding expected changes in managerial conceptual structure following the introduction of the computerized decision support system are presented. Decision protocols, in which the manager presents his own reasoning for making portfolio revisions as they occur or shortly after they have occurred, are also provided. Some of the theoretical and empirical problems in obtaining and using these protocols are discussed. Finally, differences in the decision style of portfolio managers within each of the three functional areas of portfolio management within the Trust Department are described.

From the interplay of theoretical models and empirical data which constitutes the problem finding process, several hypotheses are generated which may explain why portfolio manager behavior doesn't always conform to the analytical model. Relevant data and theoretical formulations from the psychology literature are included.

In conclusion, the implications of managerial conceptual style for quality of job performance are explored. In particular, it is hypothesized that one kind of cognitive style is appropriate to well-structured jobs while another kind is well suited to jobs involving a great deal of judgment and estimation.

Finally, the hypotheses regarding the potential impact of the conversational computer system on individual decision processes and portfolio management are summarized. A monitor trace facility is described which is designed to provide data for psychological research as well as provide an objective basis for the performance evaluation of portfolio managers.

Thesis Supervisor: Michael S. Scott Morton

Title: Associate Professor of Management

MANUFACTURING INFORMATION SYSTEMS AND REQUIREMENTS PLANNING: AN ANALYTICAL SURVEY

by

Samuel J. Lasry

Submitted to the Alfred P. Sloan School of Management on May 16, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

This thesis attempts to provide the "state of the art", as well as new directions for research, in the field of Material Requirements Planning.

After delineating the distinction between "dependent" and "independent" demand, we will define Material Requirements Planning and judge its application by a sample of a dozen companies. We will then list major unresolved issues, and propose tentative solutions. We will finally point to promising avenues for further research, and describe where and how they might be most fruitful.

Thesis Supervisor: Stuart E. Madnick
Title: Assistant Professor of Management

ABSTRACT

A STATISTICAL ANALYSIS FOR

A MARKETING PLANNING MODEL

by

ROBERT ERNEST LEVASSEUR

Submitted to the Alfred P. Sloan School of Management on January 24, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

The problem of allocating marketing effort across a product line has received scant attention from model builders despite its obvious importance. Existing models tend to treat individual products in the line as if they were independent. If significant interdependencies exist, this approach to product line decision making leads to suboptimal resource allocation.

A marketing planning model which treats product interdependencies explicitly is developed in this thesis. The model consists of two components, a demand and a cost submodel. The thesis focuses on the calibration and testing of the critical demand submodel on a set of empirical market data for an established line of consumer products.

Very few interdependencies emerge from the statistical analysis. In some cases, the effects of intuitively important marketing variables such as advertising do not come through. This does not prove that the effects do not exist, but only that they were not measured by the combination of estimation techniques and data sample used.

The calibrated submodels are shown to be useful in allocating promotional effort across the product line, in assessing the economic value of advertising, and for certain forecasting purposes, such as production planning over a medium run horizon.

The thesis concludes with suggestions for obtaining better measurements of important marketing effects among products in a line.

Thesis Supervisor: John D.C. Little
Title: Professor of Operations Research and Management

THE CONSEQUENCES OF EFFECTIVE UTILIZATION REVIEW THE MASSACHUSETTS HOSPITALS-A CASE STUDY

by

Richard Henry Linden

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

Abstract

In winter 1973, the Massachusetts Blue Cross and the Massachusetts short-term general hospitals signed a contract which included provisions for a formal utilization review procedure. This thesis examines the potential consequences of effective implementation of this program on the operation of the hospital system as a whole. Utilization review is a subset among possible policy options aimed at reducing the rate of price inflation in the delivery of hospital services. Its major objectives are to eliminate unnecessary admissions and reduce length of stay for those patients no longer requiring acute medical care.

This paper describes the development and application of a systems dynamics simulation model for long range health planning. The model is specifically designed for use as an aid for policy decisions. The data used to initialize and parameterize the model included the most recent information available on patient useage, systems assets (beds), and hospital costs. The model is presented in detail and the simulation experiences are summarized and evaluated.

It was found that effective program implementation forces a dynamic response from the system. In particular, as the level of patients is reduced, hospital beds are closed and subsequently total system charges are decreased. A cost benefit analysis indicates significant incentives in favor of the program. Recommendations for future action are included.

Thesis Supervisor: Leon S. White

Title: Senior Lecturer
Commissioner of Health and Hospitals, City of Boston

THE PROPOSED EXPANSION OF THE JOSLIN DIABETES FOUNDATION: MEETING PATIENT NEEDS

by

Thomas Linkas

Submitted to the Alfred P. Sloan School of Management of the Massachusetts Institute of Technology on May, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

The Joslin Diabetes Foundation must obtain from the Public Health Council of the Massachusetts State Department of Public Health a determination of need for expansion of its facilities. Only after final approval by the Public Health Council can construction begin.

The intent of the investigation has been to assist the Joslin in the preparation of the application for determination of need. The thesis's objectives are 1) to collect, organize, and present data relevant to the determination of need 2) to evaluate the ability of the Joslin to meet present and future needs of the diabetic population, and 3) to highlight planning issues to be considered once the certificate of need has been approved.

Data relevant to the determination of need includes statistics on diabetes, demographic trends and projections, health care trends, and internal operating data of the Joslin. Evaluation of the Joslin's proposed expansion indicates that it is modest in scope; future demand both for ambulatory-inpatient beds and for outpatient services is potentially large. Suggestions for future study include such planning issues as development of an institutional referral base, determination of the Diabetes Treatment Unit bed capacity necessary to reduce the wait for admission to medically appropriate levels, the possible effects of the artificial pancreas, and the future role of the Joslin as a specialty-referral center for diabetics.

Thesis Supervisor: Leon S. White
Title: Senior Lecturer

A SYSTEMS FRAMEWORK FOR MARKETING COMMUNICATIONS EQUIPMENT: A CASE STUDY OF AUDIO RESPONSE

by

Robert Gordon Lister

Submitted to the Alfred P. Sloan School of Management on May 20, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This thesis has two purposes. The first, is to develop a framework for analyzing a market for new communications equipment. The second is to apply this framework to market analysis for audio response equipment. Information regarding the history and opportunities for audio response equipment was obtained through personal interviews with the manufacturers that are presently in the market place, users who have experience with this type of equipment, and potential users.

The systems framework that was developed is a multistep iterative process structured around the DIME model and a comprehensive checklist. The model is iteratively modified taking into account the unique factors of the industry involved. To assure comprehensiveness, a checklist is provided. In the case of communications equipment, the systems framework is utilized to develop the DOLLAR model. This model is a refinement of the four step, descriptive DIME model and is custom tailored for the industry involved.

Although audio response has been around for about 10 years, technological advancements are just starting to permit widespread applications. The DOLLAR model is used to analyze the steps a firm should use in preparing a new product for the market. Particular equipment features are included as a result of interviews with users and potential users. These features are also compared to present equipment capabilities with an emphasis on the inherent advantages and disadvantages of audio response techniques.

The ultimate test of both the systems approach and the audio response study would be to apply it to a firm developing such a product. This is obviously outside the scope of the thesis, although many of the individual aspects have been implemented by the existing equipment manufacturers.

Thesis Supervisor: Gordon F. Bloom
Title: Senior Lecturer

MULTIDIMENSIONAL SCALING AND THE DATA BASE

Further Empirical Evidence

on Related Issues

by

LUIS FELIPE MANTILLA BARTRA

Submitted to the Alfred P. Sloan School of Management
on May 11, 1973 in partial fulfillment of the requirements
for the degree of Master of Science

ABSTRACT

This thesis evaluates several different approaches and alternatives to the area of multidimensional scaling. The data base consists of direct dissimilarity measures and stimuli ratings on a seventeen construct scale.

In particular, the main areas covered are: 1) derived vs. direct vs. three way analysis of dissimilarity; 2) aggregate vs. individual analysis of dissimilarity; 3) data base problems and; 4) algorithm dependent problems.

The findings will also give added insight into the cross-sample validity of the Green and Rao* results.

Thesis Supervisor: Alvin J. Silk

Title: Associate Professor of Management Science

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*Green, P.E., and V.R. Rao, Applied Multidimensional Scaling, New York: Hold, Rinehart, and Winston, Inc., 1972.

AUDIO-VISUAL AIDS TO COMPUTER EDUCATION

by

Michael G. McGuire

Submitted to the Alfred P. Sloan School of Management on 22 May in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

Probably because of the hectic pace of advance in computer technology, little has been done until very recently to develop audio-visual materials for educational purposes in this area. Now, however, three companies are producing materials that could prove quite interesting to colleges and universities, which are faced with the task of educating in this field students of widely varying technical backgrounds. The purpose of this report is to develop criteria for judging the usefulness of these materials to students and professors at the Sloan School of Management. These criteria are then applied to the materials of two companies-Deltak, Inc. and Edutronics, Inc.-to determine whether these materials could be applicable in the Sloan environment. One of the Management Information Systems courses at Sloan is then used to illustrate how those materials judged applicable could be incorporated into a typical course.

In developing the criteria, consideration was given to a number of areas. The various objectives of education were discussed as well a teaching methods that can be used to accomplish them. Classification of materials turned out not to be a trivial problem and is discussed in some detail. In addition, the evaluative criteria of other authors are considered. These diverse elements are then examined in light of the particular educational environment of the Sloan School to arrive at a set of criteria suitable for judging various audio-visual materials, which are directed to computer education.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

MULTIPERIOD ADAPTIVE CONTROL OF THE WELLHEAD PRICE OF NATURAL GAS; A BAYESIAN DECISION THEORETIC APPROACH

by

- Cyrus Rustam Mehta

Submitted to the Alfred P. Sloan School of Management on August 3, 1973 in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Abstract

This dissertation provides a methodology for the multiperiod adaptive control of one or more policy variables belonging to a system of linear simultaneous equations by Bayesian methods. The methodology is developed in the context of a specific problem, the dynamic regulation of the wellhead price of natural gas. A mathematical model is first formulated which can probabilistically predict the magnitude of the additions to natural gas reserves and the supply of produced gas due to new contracts for specified values of the wellhead price of natural gas in each time period. Next a probabilistic utility function is defined over the range of values assumed by these three variables. Based on the criterion of maximizing expected utility a sequential N-period optimal pricing strategy is then evaluated. This strategy enables the decision maker to compute an optimal level for the wellhead price during time period j, on the basis of the a priori and sampling information available up to time period j-1 for $j = 1,2,\ldots,N$. Finally one and two period optimal pricing strategies are computed numerically and these results are discussed and compared. The dissertation concludes with a consideration of the general classes of policy models which can be adapted to this form of analysis and points out the limitations of the specific mathematical model and associated utility function for the regulatory problem faced by the natural gas industry.

Thesis Supervisor: Gordon M. Kaufman
Title: Professor of Operations Research and Management

THE IMPLEMENTATION AND OPERATION OF COMPUTERIZED JOB BANKS IN MASSACHUSETTS

by

JOHN JAMES MIKULSKY, JR.

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This thesis describes a study of the use of Job Bank job-matching systems by the Massachusetts Division of Employment Security. The study addressed two questions, first does the system actually work to facilitate the placement activity of the Division and second, what factors influence the system's ability to maintain this facilitative role? Data to provide answers to these questions were obtained by a review of various operating documents and a series of interviews with a wide range of staff members.

Due to the unavailability of comprehensive data, a definitive "effectiveness" evaluation was not possible. However, a number of quasi-measures would appear to indicate that the system is, at best, minimally effective, especially in servicing disadvantaged applicants. The major factors influencing this effectiveness center around the ability of the system to actually meet applicant information needs, maintaining a solid employer interface, integrating the system into the interviewer's role, and the level of management interest.

Thesis Supervisor: CHARLES A. MYERS

Title: PROFESSOR OF INDUSTRIAL RELATIONS

Thesis Advisor: JOHN F. ROCKART

Title: ASSOCIATE PROFESSOR OF MANAGEMENT

A STUDY OF ACQUISITION STRATEGY IN SMALL SINGLE AREA BUSINESSES

BY

DOUGLAS A. MILBURY

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

Abstract

Of all the management functions, one of the least understood and most improperly practiced is that of corporate acquisition. This thesis is intended to point out those areas of the acquisition process which are of primary concern to the small, single-area business; to understand those items of primary concern in devising and implementing a viable acquisition strategy.

A study of two small corporations with prior successful acquisitions was made in order to analyze a real situation and provide a description of that company's successful acquisition strategy. Executives of a large bank and certified public accounting firm, involved in business acquisitions and mergers were interviewed to obtain another viewpoint. Current relevant written and published information was analyzed and consolidated in order to give added perspective and understanding to the data gathered from the case studies and interviews.

The major conclusions derived from this study are summarized as follows:

1. The more definitive a company is in assessing its own goals and strengths and weaknesses, the greater the possibility of a successful acquisition. The criteria and methods developed to evaluate a prospective acquisition originate from this inward assessment.

2. The motivation and leadership of the chief executive officer has a direct positive psychological effect on his own company and the prospective seller. This is especially true during negotiations if there is an honest and frank exchange between the executives of the two companies.

3. Convincing salesmanship by the chief executive on the reason "why" to merge can override most impediments and the ability to determine a good deal from a bad one rests solidly on judgment and innate business capabilities.

Thesis Advisor: Mason Haire
Title: Alfred P. Sloan Professor of Management

Abstract

TITLE: Interactive Debuggers
AUTHOR: Charles R. Monet
Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

Interactive debugging is analyzed. First, general notions of bugs (algorithm errors) and debugging (testing, location and correction) are discussed. A formal framework is then constructed for the debugging process and the debugging event. The event (the cessation of normal processing so that debugging actions can occur) is the focus of further analysis. Five types of debugging systems are then outlined:

1) Object code interpretation
2) Source code interpretation
3) Compiled (assembled) debug instructions
4) Instruction substitution (breakpoint)
5) Hardware interrupt

These five types of debugging systems are then classified according to seven attributes:

1) Initial compilation
2) Running efficiency
3) Mode (interactive or batch)
4) Trap on variable reference
5) Trace
6) Foreign host debugging
7) Separate debugger required

The interpretive systems tend to have flexibility at high cost, and the object code systems tend to have less flexibility at lower cost. A cost/benefit analysis is presented of six debugging features:

1) Symbolic interaction
2) Incremental modification
3) Run backwards capability
4) Programmability
5) Extendability
6) Graphic output

It is predicted that no breakthroughs in debugging are imminent. Although present techniques will be combined to produce powerful interpretive/compiled debugging environments, bugs will remain an annoying reality.

Thesis Supervisor: David N. Ness
Title: Associate Professor of Management

HEALTH CARE DELIVERY WITHIN A DAY CARE SYSTEM

by Donovan Benson Moore

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

This thesis is designed to be a useful tool in the design and implementation of the health care component for a government funded Family Day Care System. Each logical step down the path toward the realization of an ideal model for the delivery of health care within a day care system--from a demonstration of the need to the mechanics of the model itself--is presented.

To justify the undertaking of such a topic, the need for adequate health care had to be surfaced. In the first Chapter, histories of case studies of child neglect (from Children's Hospital in Boston) due, at least in part, to the lack of a day care facility, are summarized. From these specific declarations of need, the next step is the presentation of general, but nonetheless revealing, statistics (also from Children's Hospital) depicting the strong correlation between the need for hospitalization and other variables such as economic status, health problems, and access to day care.

Once the need is established, one must look at and analyze the present facilities. Therefore, Chapter II consists of summaries of detailed interviews with the directors of a representative sample of day care systems in Massachusetts. Two systems are located in downtown Boston, the third on the edge of town in the South End of Boston, and the fourth in the rural town of Gloucester on the north shore. These interviews provide a rather complete description--including costs, methods of teaching health care, services rendered, and suggestions--of the current ability of day care systems to deliver health care to the participating children.

By recognizing the need, comparing the need to the present facilities, and assimilating the suggestions, a model for the delivery of quality health care to children participating in a day care system can be formulated--the content of the third chapter. The model answers such questions as : to what extent should parents be involved?; how is stabilization of random services obtained?; how should a health care component be coordinated?; how should it be funded? Thus, the model is designed with sufficient flexibility to allow all systems to incorporate it; and yet each system can be assured that health problems peculiar to its environment will not go unattended.

Thesis Supervisor: Leon S. White
Title: Senior Lecturer of Management

Abstract

THE ECONOMICS OF LIQUEFIED NATURAL GAS

Clinton Leigh Mouer

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

Liquefied natural gas (LNG) has become an important element in the world energy picture. The process od changing natural gas in to its liquefied form enables this energy source to be imported and exported between non-contiguous continents. Thus natural gas has become a ready substitute for oil and other energy sources in those countries which do not have sufficient natural resources within their own natural boundaries or available from friendly neighbors on the same continent. As in the case of oil, natural gas is now a trade commodity between the "have's" and "have not's".

The economics of LNG are such that it only becomes advantageous to use when indigenous supplies are inadequate or when load factors justify LNG as a peaking component much the same as pumped storage is used for peak shaving in electrical utilities. In the first case where there is not enough natural gas to meet demand to start with, LNG becomes economical for base loading and this in general increases the average cost to all consumers.

The fact that LNG as a high price commodity has a place in the U.S. energy picture is supported by showing the place that manufactured gas (now referred to as SYN gas or synthetic gas) had in the 19th and early 20th centuries as a specialty fuel. Manufactured gas played a prominent role in the development of illumination and was used extensively in the early 1800's for street lighting. Later manufactured gas was used almost exclusively for street lighting due to its superior illumination properties even though the gas was available only at a much higher price than other light sources. Only after natural gas became available in abundant quantities did it displace the higher priced manufactured gas.

Today, in addition to the use of LNG, we see a return of manufactured gas under the pseudonym SYN gas. Some very prominent people in the industry even include LNG in the SYN gas definition.

LNG can be and is being imported in to the U.S., Europe, and Japan, the major consuming countries, at prices which are attractive for peak shaving and at a price below that required for SYN gas to be competitive. LNG technology is fast approaching the point where LNG becomes competitive as a base load energy source. Already several utilities in the energy hungry northeast are using base load LNG to supply their gas customers. The economics are justified

because of large shortfalls in previously contracted gas deliveries via the pipelines from the Gulf coast area. The implication is that there is either insufficient capacity in the pipeline or that there is insufficient gas production at the well head to meet existing contractural commitments. This says nothing of the potential growth which could be made in the gas industries if the gas were available.

One likely cause of the present gas shortage is the low prices of natural gas imposed by the Federal Power Commission which has discouraged additional exploration for new natural gas reserves.

In this thesis I have attempted to show via historical analogy and two case studies of actual LNG facilities that LNG is justifiably a large constituent in the world energy picture. While the two cases illustrated (Exxon Libya and Algeria Arzew) do not turn out to be huge money makers, they at least marginally show that even these earliest projects have managed to just about break even. This is a remarkable accomplishment considering the monstrous capital investments (just over one half billion dollars for these two projects) and the complicated technology and logistics with each project involves.

In the future this author predicts that LNG and SNG will continue to play a large part in meeting the world energy demands.

ABSTRACT

Formulation of a Forecasting Model
for the Abrasive Grain Industry

by

William Douglas Neal

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

The purpose of this study was to develop an appropriate sales forecasting model for the abrasive grain industry. Efforts were divided among (1) selection of the proper model, (2) justification of possible exogenous variables, (3) validation of the resulting model, and (4) updating techniques.

Abrasive grains industry statistics used in the analysis were those as published quarterly by the Abrasive Grain Association (AGA). Because of the high correlation of industry sales to various key economic indicators, regression techniques were chosen for the models.

Three different models were developed to be used in conjunction with each other. One predicts yearly abrasive grains sales as a function of estimated durable goods production. The second forecasts quarterly sales as related to estimated durable goods production, automobile production, and a seasonality factor reflecting decreased output during the vacation season. The third model also predicts quarterly sales but uses instead the actual lagged value of durable manufacturing from the previous quarter, along with a seasonality factor.

Testing the three proposed models revealed a systematic bias caused by a time trend in the coefficients of the regression equations. Further development concluded that the models should be formulated using a weighted regression of recent data and updated continuously.

Thesis Supervisor: Warren H. Hausman
Title: Associate Professor of Management

A B S T R A C T

Computer Aided Picture Transformation
by Jean - Michel Netter

Submitted to the Alfred P. Sloan School of Management on May 11th, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

This paper reviews the transfor--mations which accept an image as input and give another image as output.

The use of such transformations for picture enhancement, bandwith compression, pre-processing for pattern recognition , and visual arts, will be considered, together with the criteria which will determine the selection of a given transformation in each case. This will be followed by a brief survey of those properties of the visual system which are directly relevant to the subject, with examples of the implications of each property. The transformations themselves will be reviewed in the third part. They will be classified at a first level by the type of variable they accept as input for the transformation, and at a second level by the variable they use as output.

Examples of applications and processes will be given not only in the computer field, but in other fields of image transformation - video, photography graphic arts - which can provide useful examples and experience.

Some fields -particularly bandwith compression - use transformations justified either by some property of the visual system of the observer -subjective quality, threshold of discrimination - or by technical and probabilistic properties of the equipment and image. Only the former transforms will be reviewed here.

Thesis Supervisor: David N. Ness

Title: Associate Professor of Management

SOLID WASTE DISPOSAL SYSTEM MANAGEMENT

by

Jakob J. Nigg

Submitted to the Alfred P. Sloan School of Management on May 4, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

This study considers the solid waste pollution problem in the greater Boston area and the disposal methods currently being utilized. The basic argument is that technological bases and management methods have been developed through extensive federal and private studies, for effective and efficient solid waste management, but are not being implemented. Basic stumbling blocks appear to be institutional and financial problems.

To accomplish this study, data were collected from cities and towns in the Greater Boston area and from manufacturers of municipal incinerators. A case study for a regional system is included.

Responsible for pollution control should be the state as specified in the General Law for air- and groundwater supply. The supervision has to be done by the division of environmental health, department of public health and the air pollution commission. The control over the management of the solid waste disposal facilities and collection should be the responsibility of the local governments. Each community should decide which solution and method they need for their particular problem. Waste disposal can be done through private contractors or with their own work force, independently or together with other cities (regional). Financing of new facilities can be through municipal bonds, issued to the operator of the new facility.

The study suggests that increased awareness of men's duty towards conservation of the environment and natural resources could significantly improve the present situation. Educational programs should be initiated to win public understanding and support for new methods and to remove some of the existing prejudice regarding costs and locations of new facilities, building of regional systems, etc. The emphasis should be directed towards reducing the quantity of refuse, establishing a market for recycled

products and disposal of the remaining waste through resource recovery processes.

A combined effort of government, industry and public is necessary to achieve this goal. The result would be a healthier environment at a reasonable cost, to the benefit of present and future men.

Thesis Supervisor: Dr. Arnold E. Amstutz
Title: Senior Lecturer

ABSTRACT

DESIGN OF A DISTRIBUTION SYSTEM
by
Alfonso Ocampo-Gaviria

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

This thesis describes the warehouse location problem as well as the suitability to solve the problem using a general integer linear programming algorithm. For this purpose we used the Mathematical Programming System Extended (MPSX) that is a linear programming package produced by IBM that has the capability to process mixed integer linear programming problems using Mixed Integer Programming (MIP), an optional feature of MPSX. Then, we decided to bring more reality into the model. We felt that customer service was a very important factor that was not taken into account and we incorporated customer service by means of an additional constranit.

The results obtained using MPSX-MIP indicate that the algorithm will find a "good" solution very fast, but for large problems it may take a long time to prove optimality.

Thesis Supervisor: Arnoldo C. Hax
Title: Associate Professor of Management

ABSTRACT

A MODEL FOR PLANNING

THE OPERATIONS OF A TRUCKING FIRM

IN NICARAGUA

by

Antonio Lacayo Oyanguren

Submitted to the
Alfred P. Sloan School of Management
on May 4, 1973
in partial fulfillment of the requirements
for the degree of
Master of Science in Management.

The purpose of this thesis is to study a Nicaraguan trucking firm, Transportes Pesados de Nicaragua S.A., which faces the problem of optimizing its routing structure.

Specifically, the problem is visualized as a network of cities and a number of products that have to be transported among these cities in any given month by any one of the trucking firms operating in the country. The company is interested in finding the aggregate schedule it should follow in that month in order to maximize gross profits. This is done by taking into account the revenues earned and costs incurred in transporting these goods along the different routes, the time consumed in traveling between cities, and the total capacity of the firm.

The model used is a linear programming model. Actual data collected from company records and from several organizations in Nicaragua is used to find the parameters of the model. Sensitivity Analysis is performed on the results in order to obtain additional insight into the problem.

Thesis Supervisor: Arnoldo C. Hax
Title: Associate Professor of Management Science.

AN ECONOMETRIC MODEL

OF THE ALUMINUM INDUSTRY

by

Pascal A. Payet-Gaspard

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

In this thesis, we study the economics of the Western world primary aluminum industry, focusing on prices for ingot. First, we look briefly at the technology and the structure of the industry. Then we try to identify the areas in which models can be helpful to the managers and the use of an information system in running a commodity producing industry. After a qualitative analysis of the postwar history of prices, we build an econometric model for the Western world primary aluminum industry. The results support the assumption made beforehand of the influence of inventories on prices and of an output policy of the producers. Finally, we use the model for forecasting. The simulation results raise the question of whether the aluminum industry has reached a mature stage in its development and which returns an individual producer can expect in investing in new smelter facilities.

Thesis Supervisor: Arnoldo C. Hax

Title: Associate Professor of Management

A STRATEGY TO STUDY THE USE OF RADIOLOGY AS AN INFORMATION SYSTEM IN PATIENT MANAGEMENT

by

E. James Potchen

and

William R. Schonbein

Submitted to the Alfred P. Sloan School of Management on May 4, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

The specific objective of this work is to demonstrate the applicability of a unique statistical analysis technique to the measurement of diagnostic utility, where diagnostic utility is defined in terms of a physician's actions in response to the information provided by diagnostic procedures. The long term objective is to provide a means of processing statistical data to provide a basis for the determination of the efficacy of various diagnostic procedures. The unique statistical method used in this work is known as the entropy minimax method of pattern discovery and is based on an information theory approach to the problem of extraction of information from a collection of data by means of detecting a pattern in the data. The application of this technique to the measurement of diagnostic utility involves the demonstration of the following thesis. The diagnostic utility of a given procedure can be determined by observing whether or not the result of the procedure contributes to the definition of a pattern in the actions a physician takes, based only on the information presented by the procedure.

Elements of this thesis were tested using a data set consisting of the results of clinical and radiological examinations of 1563 patients suffering skull trauma. These data consisted of coded responses by examining physicians as recorded on a prospective questionnaire, followed by the outcome of the radiological examination. These data were processed using a computer program which approximated the general entropy minimax pattern detection algorithm, with the objective of demonstrating the ability of the technique to identify patterns of diagnostic attributes which were meaningful to practicing physicians. The results indicate that the entropy minimax pattern discovery technique could identify meaningful patterns and that the technique will be useful in the analysis of more complete efficacy data when such data becomes available.

Thesis Supervisor: Arnoldo C. Hax
Title: Associate Professor of Management

RESPONSIBILITY ACCOUNTING AND MANAGEMENT-BY-OBJECTIVES: A COMPARATIVE STUDY

by

Anthony J. Quayle

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

An initial survey of concepts of performance appraisal arising from responsibility accounting and management-by-objectives finds a considerable congruence in terms of the desirability of appraising on the basis of business results and leads into a more wide-ranging comparison of the two approaches in terms of planning, goal-setting, reviewing and appraising. The system of M.B.O. put forward by John Humble is used as a base and others contrasted where appropriate.

It is found that there is no difference in planning under both approaches. Two motivational styles are identified in budgeting, that of motivating through ex-post analysis of variances (motivation by pressure) and that of motivating through fitting the budget goal to the responsible manager's level of aspiration (motivation through achievement need). A similar dichotomy is possible in the use of M.B.O., although it is found that almost all writers favor the latter approach.

It is suggested that both responsibility accounting and M.B.O. fall short of providing objective appraisal due essentially to inter-dependence between responsibility centers and the fact that reporting business results on an interim basis leads to a neglect of the time-dependence of current decisions. Both, however, can provide a substantial input to appraisal.

Thus, M.B.O. is seen primarily as a part of planning and control and, in view of the commonalities noted, an integration is proposed by administering M.B.O. through the controller's department in an attempt to achieve an operational and motivational compatibility. A number of potential advantages are discussed and finally the problems of the staff departments - controller's and personnel - in assuming different roles are addressed.

Thesis Supervisor: Michael S. Scott Morton

Title: Associate Professor of Management

Abstract

Thesis Title: Evaluation of an Automatic Programming System for Management Information Systems

Author's Name: Jeffrey Lawrence Rosenberg

Submitted to the Alfred P. Sloan School of Management on July 25, 1972, in partial fulfillment of the requirements for the degree of Master of Science in Management.

The decision to pursue a research program with the object of building an automatic programming system is examined. The specific goals of this work, and the problems involved, are discussed, in general and in relation to the specific application chosen as the first target: management information systems. The relevant areas of current technology are examined, and a set of goals and criteria for the current effort, as well as for automatic programming in general, are proposed. Preliminary results of the first six months of work are presented, along with a summary of the current status and future prospects of on-going projects. The relationship of automatic programming systems to the design, implementation, and usage of management information systems is examined.

Thesis Supervisor: William A. Martin

Title: Associate Professor of Management

THE RELATIONSHIP BETWEEN THE PRICE DIFFERENTIALS BETWEEN NATIONAL AND PRIVATE BRANDS OF SUPERMARKET PRODUCTS AND THE ADVERTISING-TO-SALES RATIOS OF THE NATIONAL BRANDS

by

Alexander N. Rossolimo

Submitted to the Alfred P. Sloan School of Management on June 25, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

Abstract

This thesis investigates the relationship between the relative price differentials between nationally advertised brands and private labels of supermarket products and the advertising-to-sales ratios of the national brands. The relative price differential is equal to the ratio of the difference in the retail prices of a national and an equivalent private brand to the price of the private brand.

The sample of 48 product categories consists of 3 product groups: 26 food products, 12 household products, and 10 health & beauty aid items. The prices were recorded in supermarkets in the Cambridge area operated by four major chains, in mid-1973.

For all 48 product categories, the correlation coefficient between the relative price differentials in mid-1973 and the advertising-to-sales for 1972 is equal to 0.61. For each of the 3 product groups, as well as for all 48 product categories, the relative price differential tends to increase with an increase in the advertising-to-sales ratio. For a given value of the ratio, on the average the health & beauty aids group has the highest relative price differential; the household products group has the second highest differential; and the food products group has the lowest differential.

We also find that the relative price differential in mid-1973 tends to increase with the total advertising expenditures by each national brand during 1972. The correlation coefficient between the differential and the advertising expenditures, for all 48 product categories, is equal to 0.40.

In order to interpret our results, we hypothesize that the degree of product differentiation, supported by advertising, achieved by a national brand is positively correlated with the profit rate from the national brand to its manufacturer, which in turn is positively correlated with the possible discount to the buyer of the equivalent private label brand.

A Cutting Plane Method for the Fixed Cost Problem

by

Jean-Marc Rousseau

Submitted to the Alfred P. Sloan School of Management on August 17, 1973 in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Operations Research.

ABSTRACT

The fixed cost linear programming problem (FCLP) refers to a linear programming problem in which each variable incurs a fixed cost or charge, in addition to its linear cost, whenever the variable takes a strictly positive value. This problem and its generalizations have a wide set of applications in business and economics; among these, we find the warehouse location problem, the routing problem, and the fixed cost transportation problem. The thesis begins with a survey of these applications and the extraction of a standard form for the FCLP problem on which further analysis is based. It is shown how the variations can be transformed into the standard form.

Our study is devoted to the development of a cutting plane method and its role in the perspective of a general framework (essentially a branch-and-bound) for FCLP algorithms. Most algorithms found in the literature could easily be classified in the context of the general procedure. Analysis of the structure and properties of the problem reveals that algorithms which seek local minimum points (minimum with respect to neighborhood) are almost certain to be non-effective because of the proliferation of these local minima.

The cutting plane method developed in the thesis (the FCLP cut) comes as the generalization, for the non convex case, of outer linearization methods used for convex problems. The FCLP cut is developed from a linear under-approximation of the FCLP objective function. This function is constructed at each step from the linear approximation of the marginal change in cost induced by unit changes of non-basic variables at a given feasible point. Convergence properties of the method are studied in depth and sufficient conditions for convergence to a global optimal solution are identified. Since the cutting plane method is to be used in conjunction with a general branch-and-bound procedure, the existence of these sufficient conditions is not required for use of the cutting plane method. Other cuts are briefly studied including the cuts of Benders, Tui, and Gomory. The most interesting fact is the constructive similarity we can demonstrate between the Benders and FCLP cuts; they differ only by the space in which they are derived.

Computational experimentation was conducted with the FCLP cut and clearly demonstrated the usefulness of the technique. The cut was tested in the context of both a cutting plane algorithm and a branch-and-bound algorithm. Several practical modifications are suggested in order to improve efficiency. The need and directions for larger scale testing are pointed out together with the possible generalization to other non-convex and M.I.P. problems.

Thesis Supervisor: Jeremy F. Shapiro, Associate Professor of Management

HOMICS - A REALISTIC APPROACH TO ELECTRONIC DATA PROCESSING FOR HOTEL MANAGEMENT

by

DAVID JOEL RUBIN

Submitted to the Alfred P. Sloan School of Management on December 15, 1972 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This thesis is concerned with the problem of implementing EDP systems in the lodging industry. A general survey of this industry's past experiences with EDP systems is presented and the currently available options are described and analyzed. A detailed analysis is made of the underlying problems in the industry that have impeded the development of computer systems in hotels, and a concept of an ideal management information system called HOMICS* is presented.

HOMICS is a system which combines latest state-of-the-art computer hardware and software and yet, may be presented to the hotel industry in a very simplistic and realistic approach. HOMICS I is basically an expanded regional batch processing system for a group of hotels This system is designed originally with the thought of incorporating it into HOMICS II. HOMICS II is the second stage in the development of the total HOMICS system, and consists of mini-computers in each hotel that are tied into the larger, regional computer. The combination of HOMICS I and II will produce an integrated hotel management system that can assist the hotel manager in various facets of his decision-making process.

* HOtel Management Information and Control System

Thesis Supervisor: Malcolm M. Jones

Title: Assistant Professor of Management

Abstract

PRIOR APPROVAL PROGRAMS IN MEDICAID: AN OVERVIEW AND ANALYSIS

by

John David Rudolph

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

Several prior approval programs have been introduced and implemented across the country in an effort to control and/or reduce medical costs associated with Medicaid. Prior approval in this case refers to the pre-admission screening (review and approval or denial) of perspective in-patients. The screening function has been either performed via the state title XIX agency responsible for the program (as in California and Colorado) or a designated medical foundation (as in Illinois, New Mexico and as proposed in Massachusetts). These prior approval programs are aimed directly at a primary problem responsible for excessive costs--unnecessary hospital admissions. The second major aspect of these schemes provides for in-hospital utilization review of services rendered and patient requirements in order to expedite patient discharge. This procedure addresses the problem of unnecessary hospital days.

In a study of the Medi-cal system in California, CHAP in Colorado, HASP in Illinois, CHAMP and Medicaid Cost Control Program in Massachusetts and HAPP in New Mexico, the following program goals were collected: (1) control/reduce costs, (2) reduce/eliminate unnecessary hospital admissions, (3) control lengths of stay, (4) upgrade/maintain the quality of care provided to Medicaid patients, (5) create a management system to measure program effectiveness and to identify/control abuses.

The intent of this thesis is to: (1) describe and analyze the existing programs and the effort within Massachusetts to choose and implement one of the two major program proposals and (2) anticipate the impact of the 1972 Amendments to the Social Security Act (HR 1--Pub Law 92-603) on the future of prior approval programs and on the major participants in the health care delivery system as it applied to title XIX eligibles. Since the critical element in the PSRO concept is the physician, a physician study was conducted to identify the issues and opinions of the Bay State physicians.

The analysis of the existing programs and the Massachusetts proposals generated various criteria with which the schemes might be evaluated. A few of those criteria are: the extent of screening, detection of length of stay abuses, certification standards, program acceptability and

provision for feedback. The differences between the programs have been displayed along fifteen dimensions in a comparison matrix. Various effects have been attributed to the programs including decreased average length of stay, savings of significant Medicaid dollars, decrease in hospital admissions growth below that of the increase in eligibles and a decrease in bed days. Along with such measures of success, there have been various problems encountered from incorrect certification standards to physician rejection and sabotage. Indications are, however, that prior approval itself may not be as great a deterrent against unnecessary hospital admissions than concurrent utilization review, but that it has beneficial effects in the area of service scheduling.

The future of prior approval in Massachusetts has been greatly influenced by the passage of the Bennett Amendment into law. The greatest question and stumbling block--should a state agency or a medical foundation control the system?--was settled through the legislation which placed the responsibility entirely on the physicians. The law will effect all the major participants: the patient, the practitioner or provider, the hospital or institution, the state, the federal government, the PSRO and the state and national professional standards review councils. Several crucial issues stand out among those which are discussed: (1) physician pessimism concerning the PSRO concept and goals, (2) imbalance in the health care delivery system aggravated by the PSRO program which directs patients away from hospitals and into the arms of physicians who do not want to render service to them (mainly due to the fee structure), (3) potential overload of hospital outpatient departments, (4) physician adversion to the bureaucratic nature of the PSRO concept and to prior approval specifically (note: prior approval is not required under the PSRO law), and (5) the mechanism for physician organization surrounded by political and administrative uncertainty.

The work presented here represents an attempt to apply systematic thinking and management science techniques to the analysis of the delivery of health care to Medicaid (and, later, Medicare) eligibles. Continuing support of those facing the task of designing and implementing control systems in the public sector is sorely needed. This study shows that the PSRO program will depend most heavily upon man-machine decision support systems, statistical and financial analysis, operations management expertise and extensive organizational development efforts in order to be successful.

APPLICATIONS OF A DYNAMIC PROGRAMMING MODEL FOR THE STOCHASTIC CASH BALANCE PROBLEM WITH AVERAGE COMPENSATING BALANCE REQUIREMENTS

by

Antonio Sanchez-Bell

Submitted to the Alfred P. Sloan School of Management on May 1973 in partial fulfillment of the requirements for a degree of Master of Science in Management

ABSTRACT

This thesis studies the cash management problem when the compensating balance requirements involve an average deposit balance over a number of periods.

Two assets are considered: cash and an interest earning asset. Fixed and variable transfer costs are incurred when transferring funds from one form of asset to the other.

A dynamic programming model initially developed by Professor Warren H. Hausman is presented which theoretically solves the problem in an optimal way. Two alternative methods are also described: a simple static heuristic policy of the control-limit type, and a simple dynamic heuristic policy. The latter, however, is shown to be computational infeasible.

The optimal programming model is shown to be computational feasible. A numerical example is solved using a probability distribution of net cash flows obtained from empirical research.

The results of the dynamic programming model are compared with those obtained from a simulation model using the simple static heuristic policy. Significant improvements are found by using the dynamic programming model, and it is concluded that it is not generally optimal to use a static control limit approach.

Thesis Supervisor: Warren H. Hausman

Title: Associate Professor of Management Science

OPERATIVE DECISION PROCESSES IN ELECTRIC UTILITY FIRMS

A CASE STUDY by PHILIP R. SAYRE

Submitted to the Alfred P. Sloan School of Management on May 7, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

Two organizational studies have been undertaken to describe in case format how two large east coast electric utility companies made capital investment decisions. Both decisions were unique in character involving an activity or technical approach that was completely new to each firm. The data was gathered during a series of structured personal interviews with the participants in the decision process at four levels of management.

The data collected has been evaluated against what are generally described as the behavioral and economic theories of the firm. The study was constructed around the behavioral model, although the observations will in part support the economic model.

The major findings in analyzing the cases are:

1. Conspicuous unsatisfactory conditions greatly facilitate the decision process and minimize internal conflict.

2. The use of the decision support techniques available from management science is minimal or nonexistant.

3. The behavior of utility firms is quite similar to similar published studies on industrial companies.

4. The behavioral model of the firm is useful to predict how a small group within a large organization might behave, but the economic theory is the more useful way of predicting the long run actions of the entire firm.

The two case studies are intended to be useful to the researcher devising decision support or energy planning computer models.

Thesis Supervisor: Gordon F. Kaufman
Title: Professor of Management

COMPUTER AND DATA SECURITY: A COMPREHENSIVE ANNOTATED BIBLIOGRAPHY.

by
John Arthur Scherf

Submitted to the Alfred P. Sloan School of Management on August 13, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

Articles discussing computer and data security topics are scattered over a very large number of sources which publish articles on security on an irregular basis. This makes it quite difficult for the security consultant, the internal auditor, the computer user, the data processing manager, the business executive, or anyone else to find out what has actually been done in this field without doing extensive, time-consuming, literature research. To ease this problem there currently exists approximately seven computer security bibliographies containing from 50 to 250 entries. Although they are all less than three years old, only one has annotations over a few sentences in length, and only two use any sort of classification or index scheme. The one bibliography with paragraph length annotations is primarily concerned with very technical aspects of hardware and software access control. Most of the other bibliographies are also concerned with only certain subsets of security problems. This paper is apparently the first attempt to produce a bibliography covering all aspects of computer and data security, and having annotations that more than superficially describe each article's content.

This bibliography contains 1,022 entries. About half these entries are extensively annotated, another quarter being superficially annotated, and the rest being unannotated. All extensively annotated entries are rated as to their current usefulness and uniqueness. A subject index of 160 items is provided for referencing purposes. The introduction to this bibliography briefly discusses: privacy, security, and integrity; threats of data misuse; physical, procedural, and hardware/software security; development and scope of the bibliography; the subject index; outstanding articles and books; computer security firms; and the future. A list of 34 firms selling computer security services or equipment is presented following the bibliography.

Thesis Supervisor: Stuart E. Madnick
Title: Assistant Professor of Management Science

SOFTWARE PACKAGES AND PLANNING SYSTEMS

by

Marco Enrique Schnabl

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

This study is an attempt to gain some insights into the actual utilization of software support in the area of business planning.

The research involved interviewing six managers of software houses and time-sharing companies, and fifteen corporate planners for a period of about fifteen weeks. Besides the interviews, close and detailed reviews were conducted on the available documentation, both of software companies and planning departments. The study limited its view to the software support to the corporate planner, because that was the most accessible source of information. The study concludes with generalizations about the determinants of planning complexity, about the relation between EDP departments, planners, and software houses, about the nature of software supported planning systems.

Thesis Supervisor: Michael S. Scott Morton

Title: Associate Professor of Management

A STRATEGY TO STUDY THE USE OF RADIOLOGY AS AN INFORMATION SYSTEM IN PATIENT MANAGEMENT

by

E. James Potchen

and

William R. Schonbein

Submitted to the Alfred P. Sloan School of Management on May 4, 1973 in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

The specific objective of this work is to demonstrate the applicability of a unique statistical analysis technique to the measurement of diagnostic utility, where diagnostic utility is defined in terms of a physician's actions in response to the information provided by diagnostic procedures. The long term objective is to provide a means of processing statistical data to provide a basis for the determination of the efficacy of various diagnostic procedures. The unique statistical method used in this work is known as the entropy minimax method of pattern discovery and is based on an information theory approach to the problem of extraction of information from a collection of data by means of detecting a pattern in the data. The application of this technique to the measurement of diagnostic utility involves the demonstration of the following thesis. The diagnostic utility of a given procedure can be determined by observing whether or not the result of the procedure contributes to the definition of a pattern in the actions a physician takes, based only on the information presented by the procedure.

Elements of this thesis were tested using a data set consisting of the results of clinical and radiological examinations of 1563 patients suffering skull trauma. These data consisted of coded responses by examining physicians as recorded on a prospective questionnaire, followed by the outcome of the radiological examination. These data were processed using a computer program which approximated the general entropy minimax pattern detection algorithm, with the objective of demonstrating the ability of the technique to identify patterns of diagnostic attributes which were meaningful to practicing physicians. The results indicate that the entropy minimax pattern discovery technique could identify meaningful patterns and that the technique will be useful in the analysis of more complete efficacy data when such data becomes available.

Thesis Supervisor: Arnoldo C. Hax
Title: Associate Professor of Management

A B S T R A C T

RESOURCE UTILIZATION IN DENTAL HEALTH CARE PLANNING:
AN ANALYTICAL MODEL

by

ELEANOR L. SCHWARTZ

Submitted to the Alfred P. Sloan School of Management on August 1, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

The field of dental health care has received little attention from a systems analytic viewpoint. Need and demand for dental care are both increasing; there is a shortage of resources to supply care. This thesis first considers possible ways of improving the dental health care system. A promising approach is to train auxiliary personnel to perform tasks formerly performed only by the dentist. A mathematical programming model is developed to determine the optional combination of such auxiliaries and examine the costs involved in their use. A realistic numerical example is studied to illustrate the potential impact of the model.

Thesis Supervisor: Warren H. Hausman
Title: Associate Professor of Management

STARTING A NEW MANUFACTURING FIRM:
A CASE STUDY

Raymond N. Seakan

"Submitted to the Alfred P. Sloan School of Management on January 27, 1973, in partial fulfillment of the requirements for the degree of Master of Science."

The bicycle and bicycle accessories industry is growing. Consumers are not only buying greater numbers of bikes, but also more expensive models. Though this growth is encouraging an increase in bicycle theft, bicycle security systems now on the market do not offer adequate protection against the sophisticated tools of the bike thief.

A proposal has been made here to start a new venture based on a recently developed bicycle locking device called the "Interceptor". The features of this lock offer a much higher level of security than chain/lock combinations now dominating 95% of the high security market, while at the same time being less expensive and much lighter than these same products. A cautious interpretation of the results interviewing a limited sample of bicycle owners in the Boston area indicates a probable consumer acceptance of the product and a recognized higher level of security offered. A price of $21.95 seemed acceptable.

A study of industry markups allow the bicycle dealer between 33 and 40% profit margin on the retail price before shipping. A wholesale price for the "Interceptor" at $13.50 makes it attractive to the retailer in terms of markup (40% on retail price) and higher quality offered.

Because of the relatively high costs of dealing through a distributor (20% of wholesale price) the choice was made to sell directly to dealers. Retail bicycle stores were chosen as main outlets because of the necessity of personal selling to establish an awareness on the part of the bicycle buyer of the theft problem and the need for a high-security lock. The retailer will be offered a free lock with every 3 purchased to encourage his initial stocking. This offer will be made by a combination of direct mail and trade journal advertising. Under conservative assumptions of no growth in bike sales or sales of more expensive bicycles, the sales forecast at a 5% market share for the "Interceptor" would be 30,000 units per year.

A new enterprise based on manufacturing and selling this device would require an investment of $43,000. However, it would be an extremely profitable venture with a calculated 26% return on investment. On this basis the feasibility of starting such a company is evident.

Thesis Supervisor: Gordon F. Bloom
Title: Senior Lecturer

EVALUATION OF THE PROGRAM MANAGEMENT SYSTEM IN MASSACHUSETTS

by

Larry Jay Shorey

Submitted to the Alfred P. Sloan School of Management
on May 11, 1973 in partial fulfillment of the requirements
for the degree of Master of Science.

ABSTRACT

In 1970, a management system intended to improve government operations was developed within Massachusetts. The system was called a Program Management System (PMS). It is an improved version of Planning-Programming-Budgeting (PPB) Systems which have been used in federal and state programs since 1965. Design for PMS was completed by 1971; however, the system has not been utilized by the Massachusetts government.

This study attempts to determine the contributions which PMS offers for management in the government sector. Strengths and weaknesses of the system are discussed, and PMS is compared with PPB systems. In addition, possible reasons for Massachusetts' failure to utilize PMS are advanced. Finally, efforts underway which may involve PMS in governments around the country are discussed.

Results from this thesis indicate that PMS is indeed a valuable tool for use in public management. It is speculated that political motives were primarily responsible for Massachusetts' abandonment of PMS. Future hopes for implementation of PMS will depend on the extent to which both the executive and legislative branches of a government are willing to support the system.

Thesis Supervisor: Leon S. White
Title: Associate Professor of Management

PCS: A PROJECT CONTROL SYSTEM

by

Michael G. Smith

Submitted to the Alfred P. Sloan School of Management on 11 May 1973 in partial fulfillment of the requirements for the degree of Master of Science

ABSTRACT

This thesis presents a system design for a computer software package called Project Control System (PCS). Through interaction with PCS, a project manager can construct a reporting system which will satisfy his needs for project control information. The thesis begins by establishing the need for such a system. The assumptions which were made during the design process are then presented and discussed.

The bulk of the thesis is a functional analysis of PCS. The functions are grouped into those which structure the project data base (structure functions); those which select specific portions of the data base (selection functions); those which store and retrieve data and maintain the data base (storage functions); those which process, alter, and manipulate the project data (processing functions); those which provide an interface between the manager at a computer console and PCS (man/machine interface functions); those which provide the capability of sending messages between various users of the system (message transmission functions); and a group of miscellaneous functions.

The thesis then presents a more detailed design of the mechanisms which would be used to structure and access the data base. Finally, the work required to transform the information presented here into an operational system is discussed.

Thesis Supervisor: David N. Ness

Title: Associate Professor of Management

Abstract

Thesis Title: An Interactive Planning and Control System for a Subscription Business

Written by: Alan Spoon and John Wigodsky

Submitted to the Alfred P. Sloan School of Management on May 15, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

The objective of this joint thesis is to design and make operational a model supported planning and budgeting system for a subscription business. The aim of the system is to provide the tools necessary to operate this business in the most profitable manner.

Customers enter a series of states which characterize a typical subscription business, i.e. prospect, trial subscription, first year renewal, and multiple year renewal. Direct mail, salesmen, or media techniques may be employed to solicit customers to enroll in a trial subscription. These customers may then convert to long-term subscription, and may thereafter renew as long-term subscribers. Promotional schemes, which may be looked upon as capital investments, influence entry into and residence in income generating states.

The model based system consists of three component models which interface in a conversational mode via input and output documents. Each of the models assists decision making in a separate environment. The first is a market model which aids the manager in estimating market receptiveness to a particular promotion strategy. The second is a financial model which enables the manager to evaluate the time discounted profitability of a set of direct mail promotion strategies. The final one is a macro planning model which analyzes the macro environment for the year's operation enabling the manager to plan and project optimal annual strategies for all promotional efforts.

These are embedded in a planning and budgeting system which enables the manager to assemble and execute an annual program which is optimal with respect to any one of several criteria including profitability in the current year, profitability over all future periods, or some combination thereof, depending on organizational constraints.

Inherent in the model-based system is a financial analysis directed to the problem of asset evaluation in a subscription business. In the macro model the financial analysis directly addresses the capital budgeting problem, as the manager evaluates alternative promotional (investment) strategies in an effort to define his optimal annual marketing plan. By iterative use of the model the manager is able to determine

the best capital budget for direct mail, salesmen, and media promotional efforts. The macro model provides quarterly output documents, facilitating on-going planning and control for the whole subscription business. Information which serves as the basis for the macro model's analysis is assembled with the aid of the remaining two models.

The financial analysis developed in the model for direct mail strategies enables the manager to evaluate and rank promotional schemes which have different time structured cash flow patterns. This component micro model traces customers through various states of the direct mail subscription process, identifying net cash flows which are then discounted back to the time of execution of the initial promotion. A marginal cost/revenue analysis designates those promotion schemes which should be selected. Input to this model is derived from systematically compiled historical data which characterizes transitions between states and from market projections produced by the third and remaining component model.

The marketing analysis inherent in the planning and budgeting system enables the manager to plan strategies for his market and monitor their impacts by means of adaptive control. With quarterly updated output, the macro model assists in monitoring the performance of the manager's annual plan within the marketing environment. Conditions necessitating modification of the plan are identified with the aid of the output documents. The annual plan is supported by the periodic usage of the direct mail component model which assists the manager in detailed strategy selection.

Another aspect of the marketing analysis resides in the third component model which projects market receptiveness to large scale direct mail promotional activity focused on the initial enrollment of customers into the subscription process. The model incorporates several critical factors which have a significant effect on market response to promotions. The model's information needs are met by the manager's current plans and by exponentially smoothed information gathered from previous experience.

To support the model package described above, there must be an on-going data collection system. Information used in the model is stored as part of a data support system. As new and better information becomes available it is fed into the data bank to be used in future model runs.

The thesis gives attention to the environment in which a model supported decision system exists. In addition to the specification of a program for using the three models in an integrated fashion, the thesis discusses problems of designing interactive models for managers who are not computer oriented. Also discussed are issues surrounding the implementation of the kind of model system developed within.

Thesis Supervisor: John D. C. Little
Title: Professor of Management and Director of Operations Research Ctr.

TABLECLOTH CORPORATION: A CASE STUDY OF FORECASTING AND INVENTORY CONTROL IN THE PLASTIC TEXTILE INDUSTRY

Stephen Lee Tanenbaum

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management.

ABSTRACT

Tablecloth Corporation, the firm being studied, manufactures plastic tablecloths and sells them to several of the major national chain stores. Recently, Tablecloth Corp. has received a new exclusive contract from Southern Stores, their largest customer, which will increase sales by introducing a fourth tablecloth size, 60" round, and a second sales territory, serving Alabama and the adjacent states. The contract, or listing, allows Southern's warehouses to order nine different tablecloth pattern/color combinations for the new round size, as well as nine different pattern/color combinations for each of the original three sizes.

The purpose of this thesis is threefold. First, to forecast the demand for each of the nine new round size pattern/color combinations to enable Tablecloth Corp. to build inventory in anticipation of the first order under the new contract. After the first month of new listing orders, the Southern Stores warehouses will have achieved the desired inventory levels for each of the items purchased from Tablecloth Corp. Subsequent orders are expected to follow a stable demand pattern, until further changes are made in the contract. The second major focus of the thesis will be to develop a forecasting model which can be used to produce monthly demand forecasts based on the long term stable demand pattern. Finally, the forecasting model, and estimates of forecast errors, will be employed to improve Tablecloth Corp. inventory control and production scheduling procedures, by allocating buffer stocks more efficiently among the various items.

Based on the results of this study, a seasonalized exponential smoothing model produces the most accurate monthly forecasts. EOQ models indicate that small production lots are optimal, due primarily to an effectively zero setup cost. The detailed production scheduling system recommended gives orders on hand highest priority, while allocating slack production to build buffer stocks. During slack periods, items are ordered for production based on stockout probability, with the item having the highest probability of stockout being scheduled first.

Thesis Supervisor: Arnoldo C. Hax
Title: Associate Professor of Management

REGRESSION ANALYSIS FOR FORECASTING AND CONTROLLING EXPENSE EMPLOYEES

by

Thomas Richard Thomsen

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

The major purpose of this thesis is to examine the potential use of multiple regression analysis as a tool to aid middle level, non-technically oriented managers in the forecasting and control of expense employees in the manufacturing environment.

Most manufacturers consider nonproduction or expense employees to be a semivariable cost when it comes to preparation or control of budgets. That is; some portion of the total expense employees is relatively fixed while the remainder varies as a function of other variables of the business. This paper presents examples of how multiple regression analysis could be used by management to analyze data of the immediate past, identify those variables of the business which appear to be significant as far as the variability of expense employees is concerned; and then, through the use of available computer programs and the computer, test those variables and generate an equation which best fits the data. This equation would have expense employees as the dependent variable and, to the extent that the future is representative of the past, could be used for forecasting and control purposes.

The methodology used was to first determine if across sixteen different factories, there were meaningful relationships between expense employees and other factors of the business; such as production employees alone or production employees plus time. Then, four of the factories were selected to see if, through a more detailed analysis, relationships between expense employees could be further differentiated by types of functional organizations, and with respect to other variables of the business such as; capital expenditures, performance against budget, product mix, etc.

In addition to furnishing conclusions regarding the use of multiple regression analysis as a tool for forecasting and controlling expense employees in the manufacturing environment, equations are presented which could be used as models for each of the three functional organizations and total expense employees at four different factories. Finally, the differences in variability of the expense employees in each of the three functional organizations as related to direct employees and time are discussed.

Thesis Supervisor: Warren H. Hausman
Title: Associate Professor of Management

An Evaluation of Text Processing Systems

David Urbani

Submitted to the Alfred P.Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

Until recently, computers have been used almost exclusively for data processing functions. The payoffs for automating accounting procedures and scientific calculational procedures was large enough to justify the relatively expensive early computer systems. However, as economies of scale and new technology lower the effective cost of computer systems, new and more imaginative applications are being developed. Text processing is one of these applications, and it is to this subject that this thesis is directed.

Text processing is the application of computer technology to the production of textual information. There is a wide range of systems and capabilities available today which can be divided into three groups: automatic typewriters, mini-computer supported terminals, and multi-purpose computer supported terminals. Several systems of each type were evaluated and compared. Also, several common, and some not so common, uses of text processing were explored. Since each system has its own advantages and disadvantages, the matching of application requirements to system capabilities is the best method of system selection.

To determine the productivity increase made possible by text processing systems, three sources were evaluated: the production of this thesis, various industry reports, and a test conducted on ten subjects. The productivity increase realized all cases were significant, and ranged from 50 to 1000 per cent.

Overall, text processing has been shown to be a viable and cost effective method of producing documents in the business environment.

Thesis Supervisor: Stuart A. Madnick
Title: Assistant Professor of Management

HEALTH CARE: RIGHT, CONSUMER GOOD OR INVESTMENT?

by

W. Michael Wade

Submitted to the Alfred P. Sloan School of Management on June, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

When trying to estimate the expenditures that should be made of health care in America, economists often disagree on the role health care plays in our society. Three general approaches are found:

1) Every person has a moral "right" to adequate health care and one's socio-economic condition should present no barrier.
2) Health care should be viewed as a consumer good with the level of services provided determined by the laws of supply and demand.
3) Health care is an investment in the "human machine" and therefore net economic yield is the best guide to the amount of services that should be provided.

Which of these views or what combination of them is correct is a question which must be answered before policy decisions can be made concerning health insurance, delivery of health services and health management. Too often sweeping changes are suggested without first dealing with the underlying philosophical issues of health care's role in society. This must be done first before mutual agreement can ever be reached on U.S. health expenditures.

What is attempted here is a fair presentation of all points of view making extensive use of the available literature along with the researcher's own analysis of the arguments where appropriate.

After a comprehensive review of the literature, a number of conclusions have emerged. There were many definitional problems encountered which have contributed to a general confusion in current debates concerning exactly what is being discussed. This difficulty is particularly pronounced on the health care as a right issue. In addition, those debating in this area seem to be speaking on two very difficult levels; one group taking a strong philosophical and idealogical approach while the other is more concerned about the availability of health care to all.

Many of the arguments given in support of health care as a consumer good were found to be quite weak economically and unsupported in the literature. Health care is in fact a "different" and unique good in the market place.

Viewing health care as an investment is an approach

which should be developed to avoid incorrect estimates as to the value of health care expenditures. However, the investment approach taken by itself may lead to biasses against certain economic groups.

In short, it seems apparent that none of the three approaches is, alone, appropriate for considering health care expenditures. Each, if single-mindedly followed, seems to end in excess. Rather, final decisions must consider all views and ultimately rely on the wisdom of value judgements.

Thesis Supervisor: Leon S. White, Ph.D.

Title: Senior Lecturer

MARKETING PLANNING

FOR NEW VENTURES

IN MINICOMPUTER-BASED INFORMATION SYSTEMS

By John P. Watson

Submitted to the Alfred P. Sloan School of Management on June 18, 1973, in partial fulfillment of the requirements for the degree of Master of Science

ABSTRACT

The purpose of this thesis is to present a framework for marketing planning in the context of a new venture in a specific industry: minicomputer-based information systems. The formal framework is supplemented and illustrated with examples drawn for interviews with several new firms in the field.

The framework concentrates on the beginning phases of marketing planning, up through formation of an initial strategy. The major elements of the framework are the basic definition of the company's business the inputs to that definition (classified as opportunities and constraints), an initial market profile, analysis and selection of markets, and marketing strategy.

The mini-systems industry is currently very active and competitive, and is felt to be in need of marketing planning. The framework in this thesis is intended to be a description of what such planning should include.

Thesis Supervisor: Malcolm M. Jones

Title: Assistant Professor
of Management

ABSTRACT

THE IMPACT OF FEDERAL-REVENUE SHARING ON
THE SUBSIDIZED FAMILY PLANNING SERVICE LEVEL
IN MASSACHUSETTS

by

DAVID REID WEIR, JR.

Submitted to the Alfred P. Sloan School of Management
on May 11, 1973 in Partial Fulfillment
of the Requirements for
The Degree of Master of Science

The purpose of this study was to assess the anticipated impact of the current Nixon administration policy of Federal revenue-sharing on the subsidized family planning service level in the State of Massachusetts. Approximately 56,000 low income women, or about 49% of the estimated 114,000 in need in the State, are currently provided with subsidized family planning services. These services are financed primarily through Federal categorical (specific) grants to comprehensive family planning projects, which serve 33,000 patients, and through Federally-financed third-party reimbursements for services to physicians and hospitals, which serve 23,000 patients.

As conceived by the Nixon administration, Federal revenue-sharing will have two aspects. Under general revenue-sharing, many categorical grants currently available to state and local governments and non-profit private agencies will be eliminated in favor of unrestricted Federal disbursements to state and local governments. Under special revenue-sharing other kinds of specific grants will be consolidated into broader categories which will be allocated to state and local governments. The best current information is that categorical grants for family planning will be eliminated under any kind of revenue-sharing. Concurrently, however, Federal third-party reimbursements for family planning services will be strengthened through higher Federal matching shares for these joint Federal/State mechinisms and the imposition of penalties for the non-provision of family planning services.

The method used to assess the implications of Federal

revenue-sharing on the level (annual patient load) of subsidized family planning services in the State was a qualitative systems analysis, in which a set of interacting input variables were related to an output variable, defined as the service level. The input variables were defined as actors, contexts (constants), laws, rules, and regulations, and ideologies. Within these categories, each variable was further classified as either increasing or restraining with respect to the output variable. An increasing variable was defined as a factor which was judged to be largely fulfilling its potential for positively influencing the service level. A restraining variable was defined as an element which was judged to be largely not fulfilling its potential for positively influencing the service output. The systems analysis thus served as a basis for assessing the impact of the loss of family planning categorical grants on the subsidized service level in the State.

The conclusion of the study was that the anticipated net impact of Federal revenue-sharing on the subsidized family planning service level in Massachusetts will be to quantitatively and qualitatively depress this level. Thus, it was not felt that the system could fully compensate for the loss of the categorical grants to be eliminated under the revenue-sharing program.

Thesis Supervisor: Leon S. White
Title: Senior Lecturer

PROJECT CONTROL

AT THE MANAGERIAL LEVEL

IN THE AUTOMOTIVE ENGINEERING ENVIRONMENT

by

JOHN JAY WETZEL II

Submitted to the Alfred P. Sloan School of Management on May 7, 1973, in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

The purpose of this thesis is to identify the activities associated with the complex task of designing, developing, and testing automotive type engines prior to mass production, develop a network representation of those activities, transcribe the network into computer language, evaluate the network in the planning stage, and demonstrate some of the features of a computer assisted Management Information System for project control at the managerial level.

The Experimental Engine Project Master Network was developed at the aggregate level, and designed primarily to assist the manager in assessing the progress of the project relative to fixed target dates; it is not intended to track daily detailed events at the micro level. A method for cost and resource accounting was developed as part of the Control System.

Several specific recommendations are made as a result of this thesis and are presented in two categories: 1) the adoption of proposals developed within the thesis (exclusive of the network technique) that might contribute improvements in the orgainzation and management of the Engine Product Development Program, and 2) the implementation of the computerized network management information system for project control.

Thesis Advisor: Warren H. Hausman Ph.D.
Title: Associate Professor of Management Science

MANAGEMENT INFORMATION SYSTEMS AND AEROSPACE PROGRAM MANAGEMENT: A UTILITY ANALYSIS

by

DAVID WOOLDRIDGE

Submitted to the Alfred P. Sloan School of Management on May 11, 1973, in partial fulfillment of the requirements for the degree of Master of Science in Management

ABSTRACT

Aerospace program managers, because of the many critical decisions they must make and the variety of areas over which they must have knowledge and maintain cognizance, require a prodigious amount of information in their day-to-day management efforts. Many aerospace companies are investing heavily in the development of computerized management information systems to assist in satisfying this need for program and other managers. This thesis examines the utilization of management information systems by aerospace program managers with an emphasis on how these systems are being used, what are the problems that exist and what can be done to improve their utilization.

The initial stages to this study included a literature survey of the program management function and management information systems. From this survey a normative model of both the program management function and management information system was developed.

A descriptive model of both, describing how management information systems are utilized by program managers in one aerospace company was then constructed. Three other aerospace companies were interviewed to give the model credibility.

Using the normative model constructed via the literature search, the descriptive model was analyzed and evaluated. The results indicate that while program managers do use management information systems extensively, they feel the systems are in need of significant improvements in the areas of reliability and efficiency and are incapable of providing certain kinds of critical information, such as technical performance data, that are essential to good program management decisions.

The major problems seem to be a coordination deficiency in fitting the system's objectives to the varied needs of the many users and the inadequate methods of gathering and codifying the kinds of management information that truly reflect program progress.

Thesis Supervisor: John F. Rockart
Title: Associate Professor of Management

A Pilot Study of Planning and Control Systems Used in the Construction Industry

by

Herbert Becker Zien

Submitted to the Alfred P. Sloan School of Management on May 11, 1973 in partial fulfillment of the requirements for the degree of Master of Science.

Elements of the construction industry surely are not unique in the American economy. The output of construction firms is a one-time product, but so is that of manufacturing job shops. Competitive bidding is a common contract-awarding system in defense projects as well as building projects. Skilled labor accounts for a large percentage of costs in many types of products. Easy entry and high risk are found in contexts other than construction. It is not the uniqueness of the elements, but their confluence within the realm of a single industry that makes construction unlike any other.

The dynamics of two construction characteristics particularly seem at odds. On one hand, the competitive bidding process dictates that supervisory and overhead staffs must be minimized in order to reduce costs. On the other hand, high labor costs necessitate careful control. A basic trade-off exists, supervisory costs against labor costs.

This thesis examines how this trade-off is made in practice. It is a pilot study of planning and control systems used by contractors to manage the labor component of construction projects. Of course, merely to present these systems is not illuminating. In order to learn from them, it is necessary to develop a standard against which they can be compared.

For this purpose, a normative model of planning and control systems is extracted from the literature. The framework chosen is based on four perspectives of the problem: cybernetic, structural, behavioral, and technological. It is assumed that a good planning and control system is one that compares favorably with the normative model.

Using a questionnaire to gather data on planning and control systems in use, it is possible to test three hypotheses: general contractors have better systems than subcontractors, large contractors have better systems than

small contractors, and firms directed by professionally-trained general managers have better systems than those directed by union-trained general managers. Although this research gives some insight into the control problem, it does not provide any evidence to support these hypotheses.

Thesis Supervisor: Jerry D. Dermer
Title: Visiting Associate Professor of Management

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